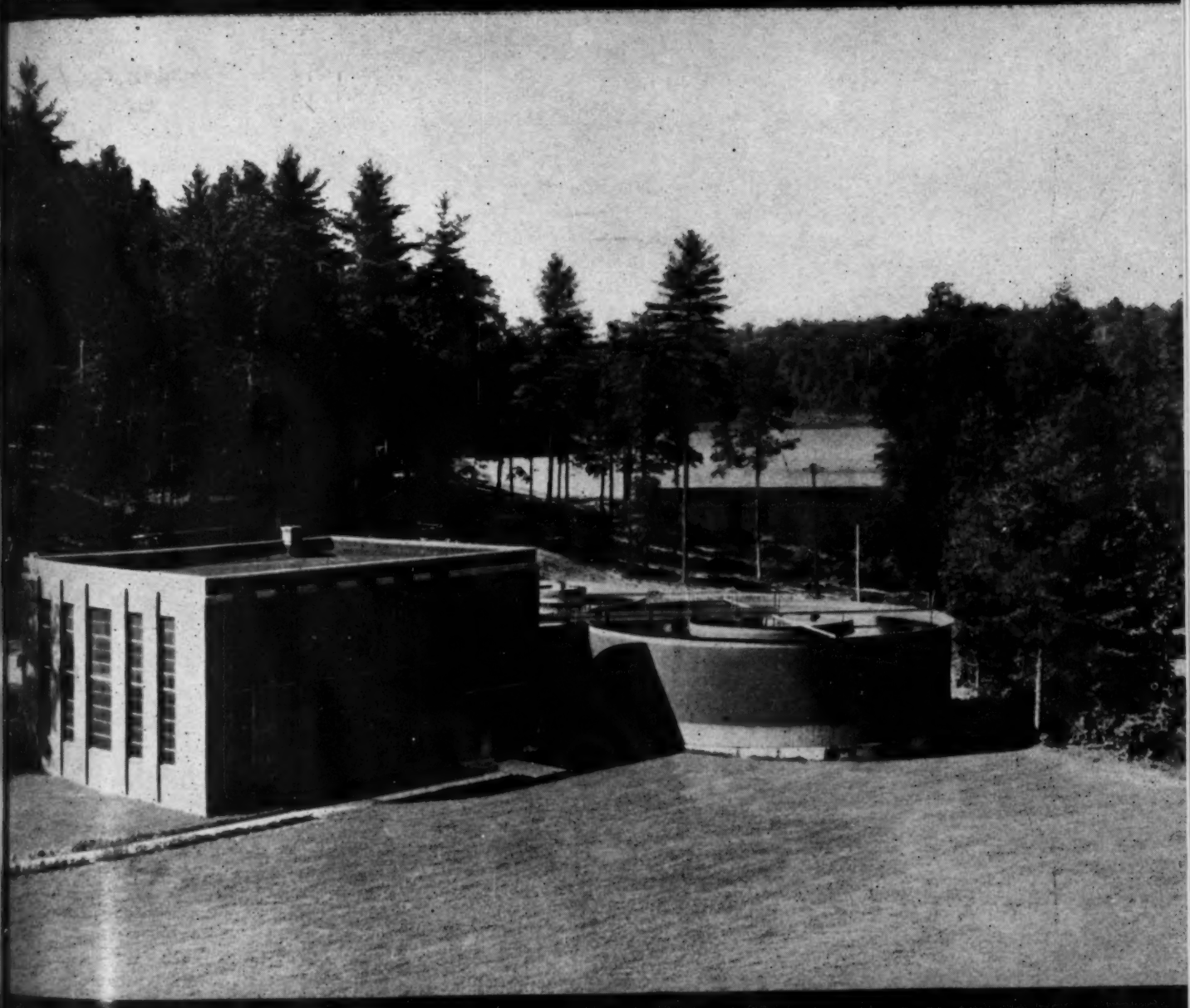
WATER WORKS & SEWERAGE

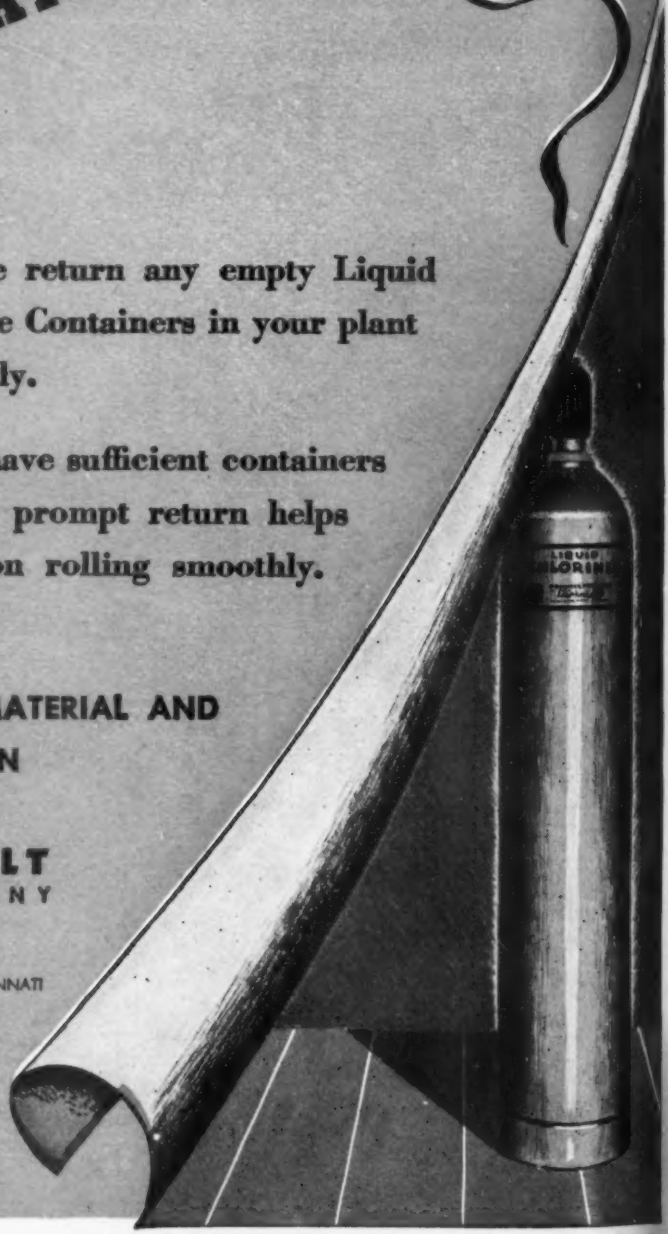


Liquid Chlorine CONTAINERS???

Please return any empty Liquid Chlorine Containers in your plant . . . promptly.

Although we have sufficient containers on hand . . . their prompt return helps us all keep production rolling smoothly. Thank you.

IDLE CYLINDERS MEAN IDLE MATERIAL AND LOST PRODUCTION



PENNSYLVANIA SALT
MANUFACTURING COMPANY
Chemicals
1000 WIDENER BUILDING, PHILADELPHIA 7, PA.
NEW YORK • CHICAGO • ST. LOUIS • PITTSBURGH • CINCINNATI
MINNEAPOLIS • WYANDOTTE • TACOMA

WATER WORKS & SEWERAGE, May, 1945, Volume 92, Number 5. Published monthly by Gillette Publishing Co., 330 South Wells Street, Chicago, Ill. Per copy, 25c. Subscription rate, United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under act of March 3, 1879.

Sweep-Dial TEST HANDS

CIRCULAR READING CUBIC FEET

CIRCULAR OR STRAIGHT READING REGISTERS, RECORDING IN EITHER GALLONS OR CUBIC FEET ARE OPTIONALLY FURNISHED

STRAIGHT READING GALLONS

LIKE THE SPLIT SECOND HAND OF A STOP WATCH

THE MOST COMPLETE LINE OF WATER METERS IN THE WORLD

Pittsburgh
Arctic and Tropic Disc Type

Empire
Oscillating Piston Type

IMO Screw Propulsion Type

Pittsburgh-*Empire*
Current and Compound Types

ASSURE ACCURATE PROVING DETECT PLUMBING LEAKS

All types and sizes of PITTSBURGH-EMPIRE Water Meters are fitted as standard equipment with registers having a large red center test hand. This hand sweeps the entire outer circumference of the dial face, making a complete revolution of the dial circle for each ten gallons, or one cubic foot, measured by the meter.

This feature is of material assistance and convenience when testing meters, since a much closer reading can be obtained than when testing against the conventional small circle test hand. It is furnished by PITTSBURGH-EMPIRE as an aid to the industry for closer registration from both new and repaired meters.

The sweep dial test hand performs another useful function too, that of detecting leaks in fittings or service pipes on metered premises. With all faucets closed, the slightest movement of the large center hand can be readily observed—thus showing that water is being wasted at some point beyond the meter.

Registers with sweep dial test hands are just another extra value that meter buyers have learned to expect from products made by the Pittsburgh Equitable organization.

PITTSBURGH EQUITABLE METER COMPANY

Atlanta Houston Chicago Pittsburgh Kansas City

MERCO NORDSTROM VALVE CO.
Main Offices, PITTSBURGH, PA
Los Angeles Boston Tulsa Seattle San Francisco New York

National Meter Division, Brooklyn, N. Y.

Water Meters

How to Build Big Sewers QUICKLY

This storm sewer job along the East coast really "marched" because the engineers used rugged ARMCO MULTI PLATE *Arches with their quick assembly and backfilling features. No delay, no form-work, no curing. The installation has a 20-ft. span, 10-ft. rise, and is 1800-ft. long.*

Design and construction of large storm or intercepting sewers can be simple and quick.

For spans ranging from 10 to 28 feet, ARMCO MULTI PLATE Arches provide a logical form of construction. First is the reinforced concrete base with low, grooved "abutments" at either side to support the arch plates above the flow line. Next is quick assembling and bolting of the MULTI PLATE arch, followed immediately by backfilling *directly against the metal.*

No delay, no complicated formwork, no waiting for the arch to cure. Curved alignment, connections and manholes are no problem.

Why not have all these advantages for your post-war jobs? Ask for the blue covered descriptive bulletin on "ARMCO MULTI PLATE Pipe and Arches." Just get in touch with our nearest company—or write Armco Drainage Products Association, 705 Curtis Street, Middletown, Ohio.

ARMCO MULTI PLATE SEWERS

AQUA NUCHAR
going into Action

Close to our fighting lines in many parts of the world, Aqua Nuchar Activated Carbon is functioning in the same way it operates in communities all over America . . . it is removing tastes and odors by ADsorption to make water more palatable.

As any G.I. will gladly tell you, there's lots of truth in the statement that an army marches on its stomach. Our fighting men deserve whatever respite and refreshment they can get from clear, palatable water. Consequently, after G.I. Joe moves up, Uncle Sam moves in stocks of Aqua Nuchar Activated to make sure that his drinking water is easy on the palate . . . water that may have been purposely contaminated by a retreating enemy.

When our armed forces employ Aqua Nuchar, they are using the same purification principle that waterworks engineers all over America have endorsed for many years.

Fortunately, supplies of Aqua Nuchar are sufficient to make large shipments to our armed forces with plenty left over to supply the home front.

Investigate Aqua Nuchar . . . the activated carbon that makes possible the delivery of palatable water!

BLUEPRINT NOW

But above all, remember there is a war yet to be won. Maintain equipment to assure operation at 100% efficiency.

NUCHAR — INSURES PALATABLE DRINKING WATER

INDUSTRIAL CHEMICAL SALES

DIVISION WEST VIRGINIA PULP AND PAPER COMPANY

230 PARK AVENUE, NEW YORK 17, N.Y. — 35 E. WACKER DRIVE, CHICAGO 1, ILLINOIS — 748 PUBLIC LEDGER BLDG., PHILADELPHIA 6, PA. — 844 LEADER BLDG., CLEVELAND 14, OHIO

Lay it with Confidence

Among products that have been proved by many years of experience, cast iron pipe is in the highest rank. Consider its truly remarkable record.

Cast iron water mains were pioneered in America 120 years ago. Today, in 200 out of 212 of our largest cities, some or all of the original cast iron mains are still in service, in many instances after more than a century. In the 15 largest cities, more than 95% of the pipe in the water distribution systems is cast iron pipe. In the three largest cities –

Based on Experience

New York, Chicago, Philadelphia—the ratios are respectively, 97%, 99% and 98%. Thus it is evident that top-flight engineers *continue* to endorse the judgment of four generations of water works men.

Confidence, based on experience, is doubly important in the case of pipe to be installed underground for distribution mains. They represent the major investment in a water supply system. So we say *—trust the pipe you know about.*

Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, Peoples Gas Building, Chicago 3, Ill.

THE 10 REQUIREMENTS FOR UNDERGROUND MAINS UNDER NORMAL CONDITIONS

LONG LIFE: In evaluating bids, the useful life of cast iron pipe is figured at 100 years minimum.

CARRYING CAPACITY: The carrying capacity of standard tar-coated cast iron pipe remains practically unimpaired for centuries. For the certain areas where tuberculating water is encountered, cement-lined cast iron pipe is available. Under such conditions, no other material offers the combined long life and sustained carrying capacity of cement-lined cast iron pipe.

TIGHT JOINTS: For *ordinary* pressures, cast iron bell-and-spigot pipe—for *high* pressures, cast iron mechanical joint pipe—are known to be leak-proof.

TENSILE STRENGTH: When tested under hydrostatic pressure to destruction, the ultimate tensile strength of cast iron pipe is a minimum of 11,000 p.s.i. for pit cast pipe and a minimum of 18,000 p.s.i. for cast iron pipe made by other methods.

BEAM STRENGTH: Under beam stress tests, 10 ft. span, standard 6" cast iron pipe sustains a load of 15,000 pounds and bends approximately one inch before breaking.

TOUGHNESS: Under hydrostatic pressure and the impact of a 50 lb. hammer, standard 6" cast iron pipe does not crack until the hammer is dropped four feet.

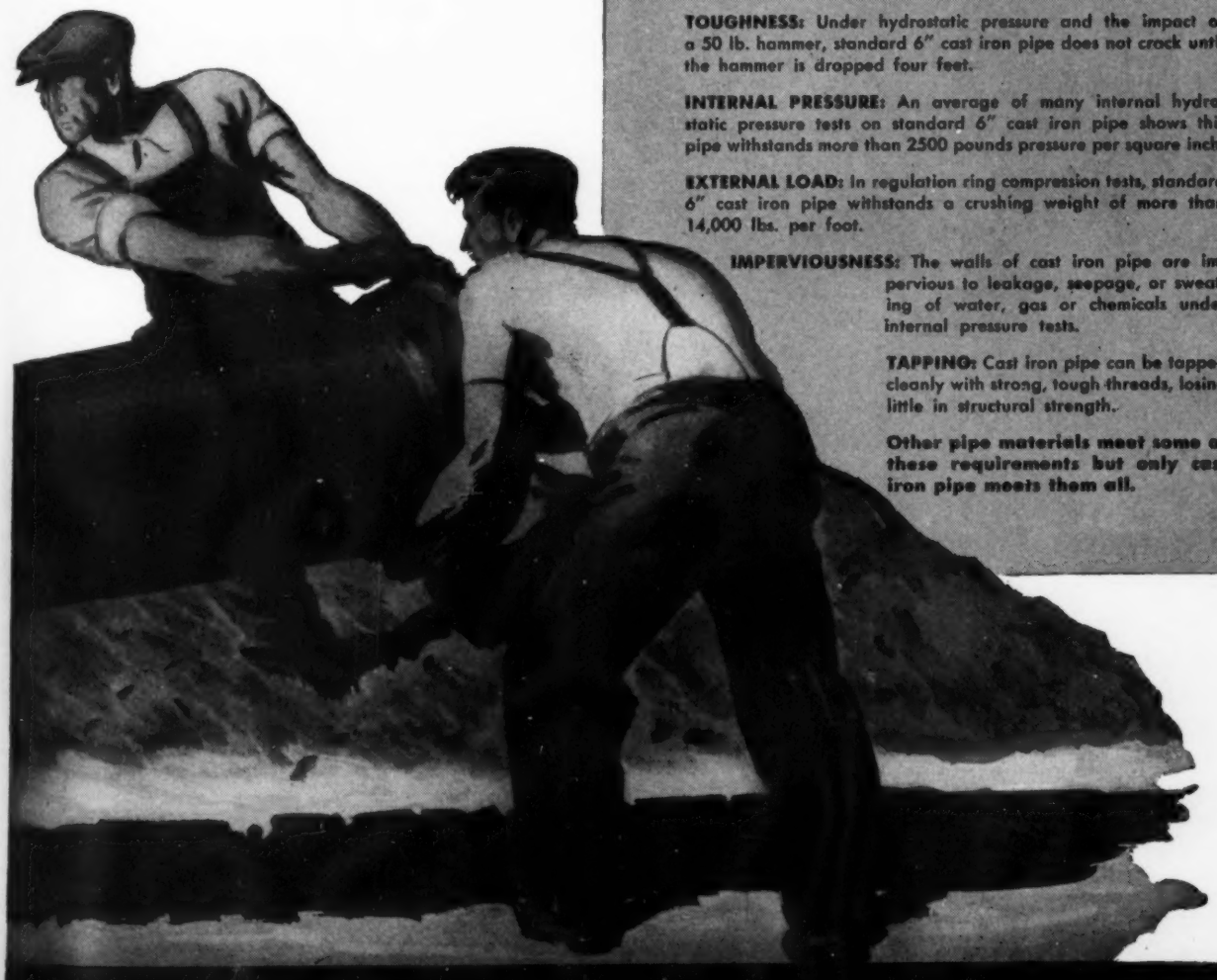
INTERNAL PRESSURE: An average of many internal hydrostatic pressure tests on standard 6" cast iron pipe shows this pipe withstands more than 2500 pounds pressure per square inch.

EXTERNAL LOAD: In regulation ring compression tests, standard 6" cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

IMPERVIOUSNESS: The walls of cast iron pipe are impervious to leakage, seepage, or sweating of water, gas or chemicals under internal pressure tests.

TAPPING: Cast iron pipe can be tapped cleanly with strong, tough threads, losing little in structural strength.

Other pipe materials meet some of these requirements but only cast iron pipe meets them all.



SERVES FOR CENTURIES

Tax Saver No 1

3,000 GALLONS PER HOUR

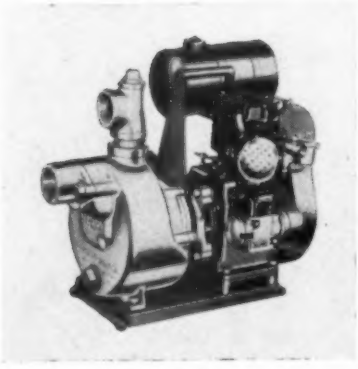
. . . IN ONE HANDFUL

A mighty midget -- indispensable for all pumping around water works and sewerage plants. Handles any solid that will pass suction intake. Fast, automatic priming -- no efficiency loss through by-passes! Rugged durability -- easy portability -- proved dependability. All models now available in aluminum construction.

MIDGET
One man portability - easily carried from job to job.

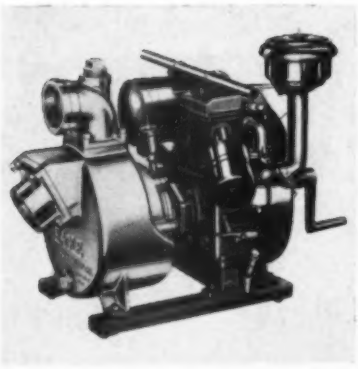
THE MIDGET

3,000 G. P. H.
Suction 1½"
Discharge 1½"
Net weight 60 lbs.
Length 18½"
Width 9¾"
Height 15½"



THE HAWK

8,000 G. P. H.
Suction 2"
Discharge 2"
Net Weight 100 lbs.
Length 25"
Width 18"
Height 20"



THE EAGLE

15,000 G. P. H.
Suction 3"
Discharge 3"
Net Weight 120 lbs.
Length 31½"
Width 20"
Height 22"

ENCOURAGE ENLISTMENT IN THE WAC (Women's Army Corps)

ARMY (E) NAVY

GORMAN-RUPP

MANSFIELD · OHIO

GORMAN-RUPP PUMPS
UNSURPASSED FOR PUMPING EASE

When the Bell Rings . . .

This advertisement appeared in June, 1943. Since that time many have started their post-war planning with Simplex. If you haven't yet begun, we feel the context of this advertisement is as timely as it was two years ago . . . but the need is more urgent. BLUE PRINT NOW . . . and act.

Plant superintendents, council members, city commissioners, and other officials, all are talking about war and its many urgent problems . . . and just as earnestly these same men are thinking of the urgent problems they will face after the war.

We sincerely believe that much of your post-war planning can and should be started now, when you and your consulting engineers have the opportunity to analyze your over-all program and prepare a plan of action which is commensurate with your future needs. Then, when the bell rings and you've torn up the last set of priority papers, you will be ready—engineered for immediate progress.

Simplex Valve & Meter Company has been collaborating in such long-time planning for over forty years. Our outlook, therefore, is broad and is based on sound experience. We know many of the problems involved and can offer the solution to most of them. We are prepared to help you plan for the future — starting today.

SIMPLEX VALVE & METER COMPANY

6743 UPLAND STREET, PHILADELPHIA, 42, PENNA.

WHAT DO YOU KNOW ABOUT *Everdur*

. . . FOR THESE ITEMS OF SEWAGE TREATMENT EQUIPMENT

Coarse and Fine Screens • Float Chambers • Swing Gates • Built-up Sluice Gates • Coarse Bar Rack Aprons • Effluent Weirs and Scum Weirs • Structural Scum Baffle Brackets • Troughs • Screen Hoppers • Orifices • Baskets • Anchors • Ladders • Float Gage Chains • Valve Springs • Manhole Steps • Guides • Walkways • Electrical Conduit.

. . . AND THESE RESERVOIR AND WATERWORKS APPLICATIONS

Bolts • Flashboard Supports • Flush Box Fittings • Pipe • Screen • Screen Frames • Spillway Fittings Steps • Valve Stems.

The record of Everdur* for sewage treatment and water service is outstanding. Equipment of this strong corrosion resistant Copper alloy has been in service for 18 years . . . and the condition of the metal promises many more years of service.

In addition to the properties of Everdur, it is important to know that it is available in a wide range of commercial shapes, bars, plates, rods, seamless tubes, sheet and wire. Bolts and nuts made of Everdur can be obtained from leading manufacturers.

Everdur can be readily fabricated, machined and welded into almost any type of equipment you may need. You will find that it will serve as an exceptionally durable metal for new equipment and also for repair and replacement parts. We therefore suggest that you add to your reference files the following publications:

E-11—Everdur Metal for Sewage Treatment Equipment, and Water Works Service.

E-5—Everdur Metal (properties, constants, specifications, etc.).

E-6—Everdur Bolts, Screws and Accessories.

E-13—Everdur Metal Tanks and Equipment.

B-22—Anaconda Electrical Conduit.

Any or all of them will gladly be mailed on request.

*Reg. U. S. Pat. Off.

45184

Keep Faith with Your Fighters and Yourself! Buy War Bonds for Keeps!

ANACONDA

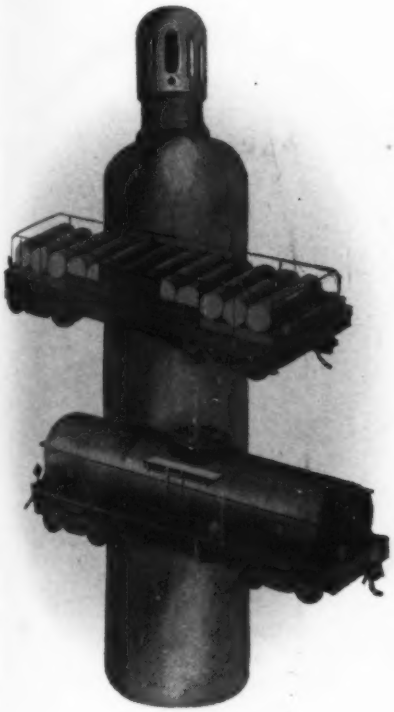
Everdur Metal

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

ALKALI

DIAMOND LIQUID CHLORINE



THE DEPENDABLE CHLORINE SPECIFICATION FOR WATERWORKS ENGINEERS THE YEAR 'ROUND

DEPENDABLE

UNIFORM

SAFE

DIAMOND ALKALI COMPANY · PITTSBURGH, PA. · AND EVERYWHERE

WHEREVER WATER-WORKS PROJECTS

A PROPOSAL TO IMPROVE THE WATER WORKS SYSTEM

OF N...IANA

To the Mayor and City Coun... of the

Submitted herewit... rojects
water works system ... divided
which are to ...
into ... ndertaken

...as soon as
is felt should ...

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...needed for this ...

should be increased by ...
gallons capacity on the West Side. At ...
city is served by the South Mill Street ...
inadequate. Approximately $95,000 will ...

TEXAS

NEW YORK

CANADA

CALIFORNIA

LOUISIANA

JOHNS-MANVILLE
JM
PRODUCTS

ARE PLANNED —

...it's TRANSITE PIPE for efficient water transportation

PROVED IN SERVICE in thousands of American communities . . . backed by a time-tested record for dependable performance over the years . . . this asbestos-cement pipe is today being specified for water system improvement projects everywhere.

Here are some of the reasons why it will pay you to include Transite Pipe in your plans:

No Tuberculation. Tuberculating waters can never reduce the initial high flow rate of this non-metallic pipe—a factor that contributes to its low maintenance and continued high delivery capacity.

Highly corrosion-resistant—outside, inside and all the way through! Its stubborn resistance to corrosion has been proved in thousands of installations, in all types of soils, under a wide range of service conditions.

Easy Handling. Light in weight, Transite Pipe is easy to handle—an advantage that pays off in lower transportation and installation costs. Mechanical handling equipment is not necessary except for the larger sizes.

Rapid Assembly. Even unskilled crews can assemble Transite Pipe quickly and easily with the J-M Simplex Coupling, which stays tight even when the line is deflected as much as 5° at each joint.

* * *

These and other advantages of Transite Pressure Pipe are fully described in Booklet TR-11A. For your free copy, write Johns-Manville, 22 East 40th Street, New York 16, N. Y.

Johns-Manville *Asbestos* TRANSITE PIPE

NEW PUMPS PAY

MODERN DE LAVAL PUMPS

10% to 15% more efficient than older models

De Laval single-stage, double-suction water works pump

A new pump will frequently pay for itself out of power savings within two years or less, so great have been recent improvements in pump efficiency. Let's consider a typical example:

Rate of pumping—3 mgd . . . . . Current cost—2¢ kw./hr.
Pumping head ft.—231 ft. . . . . Operation per year—5000 hrs.
Assumed motor efficiency 88%

	YOUR OLD PUMP	A NEW 1944 DE LAVAL
Pump efficiency	72%	83%
BHP	170	147
Electric HP	193	167

Power saved 19.4 kw. at 2¢ rate—38.8 cents/hr. Annual saving—5000 hrs. x .3888, or $1,940.00. A new 1944 De Laval heavy duty water works pump, with 150 hp. driving motor and reduced voltage starter, can be supplied for the sum of $2,448. Thus we have:

***Percentage return on equipment* 79½%**
***Time required to repay first cost* . . . . . 15 months**
***Annual saving after liquidation of investment* $1,940.00**

In many cases the cost can be reduced if the existing motors can still be used, making the return much greater. • Now is the time to plan water works improvements. A De Laval representative will be glad to help you work out the details.

De Laval Labyrinth wearing rings, sustain high efficiency

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG

4112

Sustained ACCURACY—

to a Trickle—and to a Maximum Capacity Flow!

EVERY fractional cubic foot of water that flows through a Badger Water Meter is recorded faithfully — whether the unit be a large Badger Compound Meter or a ⅝-inch Badger Disc Meter.

Sustained sensitivity, accuracy, durability plus easy interchange of parts — these Badger features are priceless today — in maintaining accurate records of flow at lowest cost for maintenance.

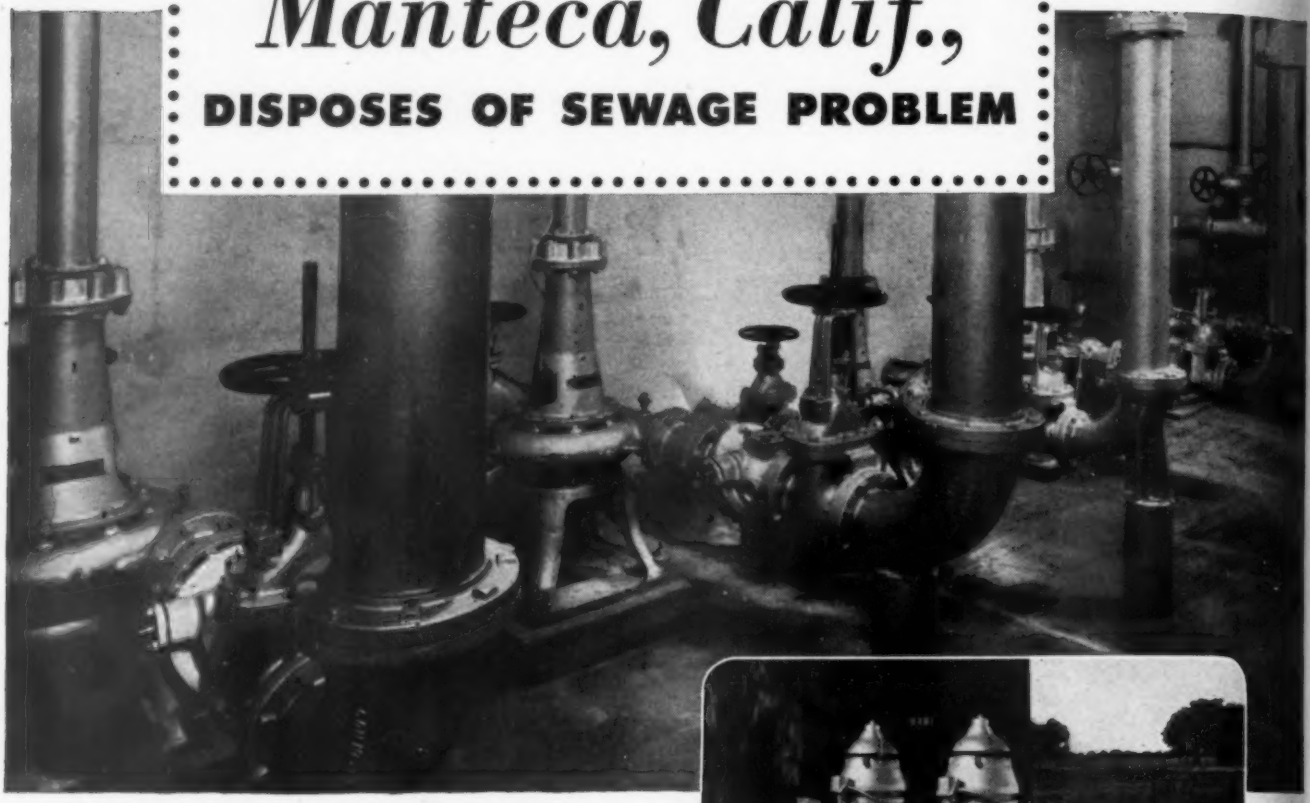
In your postwar planning, keep in mind the enviable record of Badger Water Meters for sustained accuracy and durability far beyond normal expectancy.

BADGER METER MANUFACTURING CO., MILWAUKEE, WIS.

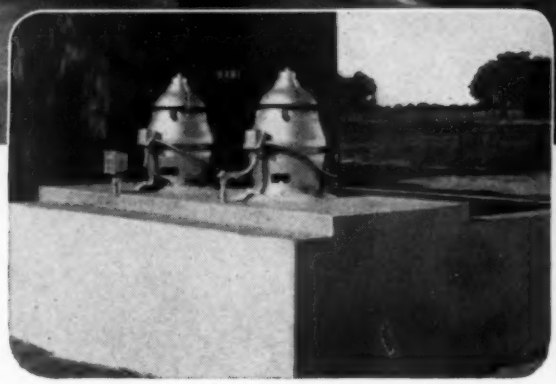
Branch Offices in: New York City • Chicago, Ill. • Waco, Texas • Portland, Ore. • Salt Lake City, Utah Seattle, Wash. • Cincinnati, Ohio • Kansas City, Mo. • Tampa, Fla. • Savannah, Ga. Los Angeles, Cal. • Philadelphia, Pa. • Denver, Colo. • Worcester, Mass.

Manteca, Calif.,

DISPOSES OF SEWAGE PROBLEM



Battery of Fairbanks-Morse dry-pit pumps at Manteca



Two Fairbanks-Morse vertical submerged pumps for recirculation

BACK in 1938 the City Council of Manteca, Calif., realized it faced an exceptional sewage disposal problem. An inadequate system coupled with enormous industrial waste volume presented many special problems. Surveys indicated this town of 2,000 needed a plant big enough for the average city of about 40,000.

From past experience the consulting engineer recommended Fairbanks-Morse Pumps. Known today as a model of efficiency and economy, the Manteca plant removes 98% of the B. O. D. from the sewage with only 50% of the power requirements of the old plant.

Fairbanks-Morse Pumps can handle your municipal sewage problem, too . . . and probably save you money. Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

Buy More War Bonds

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

Simple and low-cost operation...

a corollary to the "ALOXITE" porous underdrain system

LOW COST AND EASIER OPERATION are inherent with the "ALOXITE" ceramically bonded aluminum oxide porous plate underdrain system for rapid filters. Its use—

- **Eliminates all graded gravel**
- **Provides complete and uniform backwash**
- **Reduces operating heads**

The sectional perspective drawing shows the simplicity of construction. There is nothing to be disturbed by a violent or uneven backwash. All the difficulties resulting from upsetting of graded gravel and filter media are eliminated. Think what this may mean to you!

With the filter media resting directly on the "ALOXITE" plates, there is only one material to handle if bottom inspection is necessary. And this work can be completed in a very few minutes.

Users of the porous underdrain system consistently report that less wash water is required to maintain clean filter media. This reduces backwashing time. Both of these features provide distinct savings.

Furthermore, smaller pressure loss through the underdrain system plus reduced filter heights result in lower filtering and backwashing operating heads ... an additional aid in reducing overall costs.

These advantages can be secured in your plant by using the "ALOXITE" porous filter bottom. For more information write The Carborundum Company, Refractories, Div., Dept. W3, Perth Amboy, N. J.

"CARBORUNDUM" and "ALOXITE" are registered trade marks of, and indicate manufacture by, The Carborundum Company.

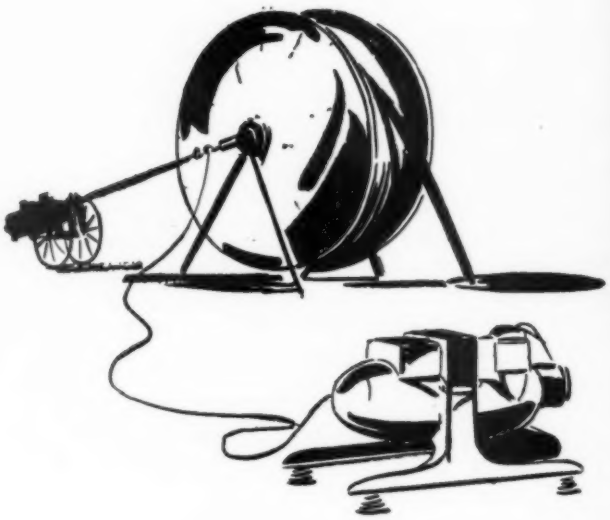
Porous Products by CARBORUNDUM
TRADE MARK

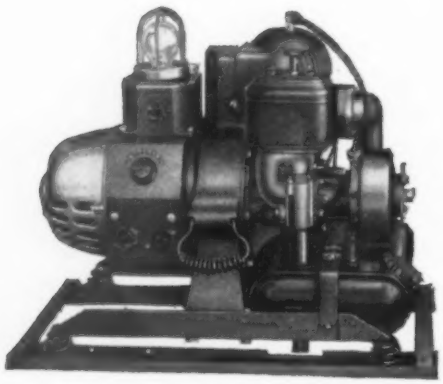
PUT A

HOMELITE ON THE JOB

AND GET IT DONE MUCH FASTER

With a 100 pound Homelite Gasoline-Engine-Driven Generator . . . a 2000 watt portable power-house ...you can operate electric wrenches and other electric tools that make it easier for your men to get things done faster. *





Capable of producing more horsepower per pound than other portable generators, a Homelite gives you longer and better service with less trouble and maintenance. Self-lubricating, air-cooled, and equipped with over-size ball bearings, the Homelite built-in two-cycle gasoline engine stands up dependably under all types of tough working conditions.

* Just one of many uses for a Homelite. Send for our new booklet showing all the time-saving uses of Homelite Portable Generators, Pumps, and Blowers.

HOMELITE CORPORATION

Portable PORT CHESTER, NEW YORK

PUMPS • GENERATORS • BLOWERS

SUBMIT YOUR PROTECTIVE COATING TO THIS tough test!

It's simple . . . and convincing!

● Just coat a steel plate with the protective coating you are now using. After the coating sets, strike it heavy blows with a hammer as shown in the illustration at the left. Note what happens!

NO-OX-ID Won't Shatter

If you are using NO-OX-ID, the *original* rust preventive, you will find a condition similar to that shown in the illustration . . . the coating merely dimples when the hammer strikes it; it does not shatter or crack in the least. Metal beneath retains its protective film.

NO-OX-ID Resists Abrasion

Protective coatings *must* be elastic and pliable under a wide temperature range if their inhibitors are to be active and if the coating is to resist abrasion. NO-OX-ID has these essential characteristics and, in addition, is tough, resilient, and non-oxidizing, retaining these properties indefinitely. This assures a tenacious bond.

Use on New Installations or for Maintenance

Apply NO-OX-ID to *new* tanks, pipes, valves, steel structures, and equipment, or use it in your regular reconditioning program.

Educational Film shown to your group on request

Educational motion picture, in color, showing the simple, effective methods and equipment for applying NO-OX-ID and NO-OX-IDized wrappers, is available for showing to interested groups. Let us know the date you would like to have us show the picture in your community.

NO-OX-ID
IRON + OX = RUST
REG. TRADEMARK
AUG. 27, 1918

The ORIGINAL RUST PREVENTIVE

Dearborn Chemical Company
Dept. Y, 310 S. Michigan Ave., Chicago 4, Ill.
New York • Los Angeles • Toronto

SYMBOL OF SERVICE

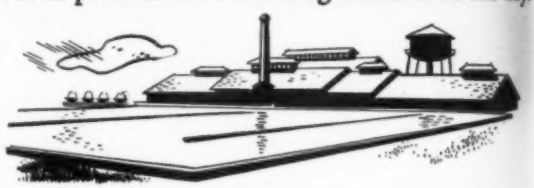
BASIC CHEMICALS

GENERAL CHEMICAL COMPANY

FOR AMERICAN INDUSTRY ©

For almost half a century General Chemical products have been a familiar sight in American Industry. So numerous are their applications, and so vital their functions, that they have long been recognized as basic chemicals which help form the backbone of many principal industries.

Year after year purchasing and operation executives *select* and *specify General Chemical Products*, knowing that the quality and utility of these chemicals have been proved in production . . . meeting demands of the day.



Because General Chemical's research and manufacturing programs are both practical and progressive, they are geared to Industry's ever-changing requirements and anticipate its future necessities. That is why General Chemical products today are for today's processes . . . that's why General Chemical products of tomorrow will meet the new demands of the industrial world!

IMPORTANT GENERAL CHEMICAL PRODUCTS FOR WATER & SEWAGE TREATMENT

ALUMINUM SULFATE

Equally Efficient For Coagulation of Water & Sewage

Ammonia & Potash Alums • Aqua Ammonia • Anhydrous Bisulfite of Soda • Sodium Silicate • Sulfuric Acid • Disodium Phosphate • Trisodium Phosphate Tetrasodium Pyrophosphate • Sodium Fluoride Sodium Sulfite

BAKER & ADAMSON

LABORATORY REAGENTS and FINE CHEMICALS

GENERAL CHEMICAL COMPANY

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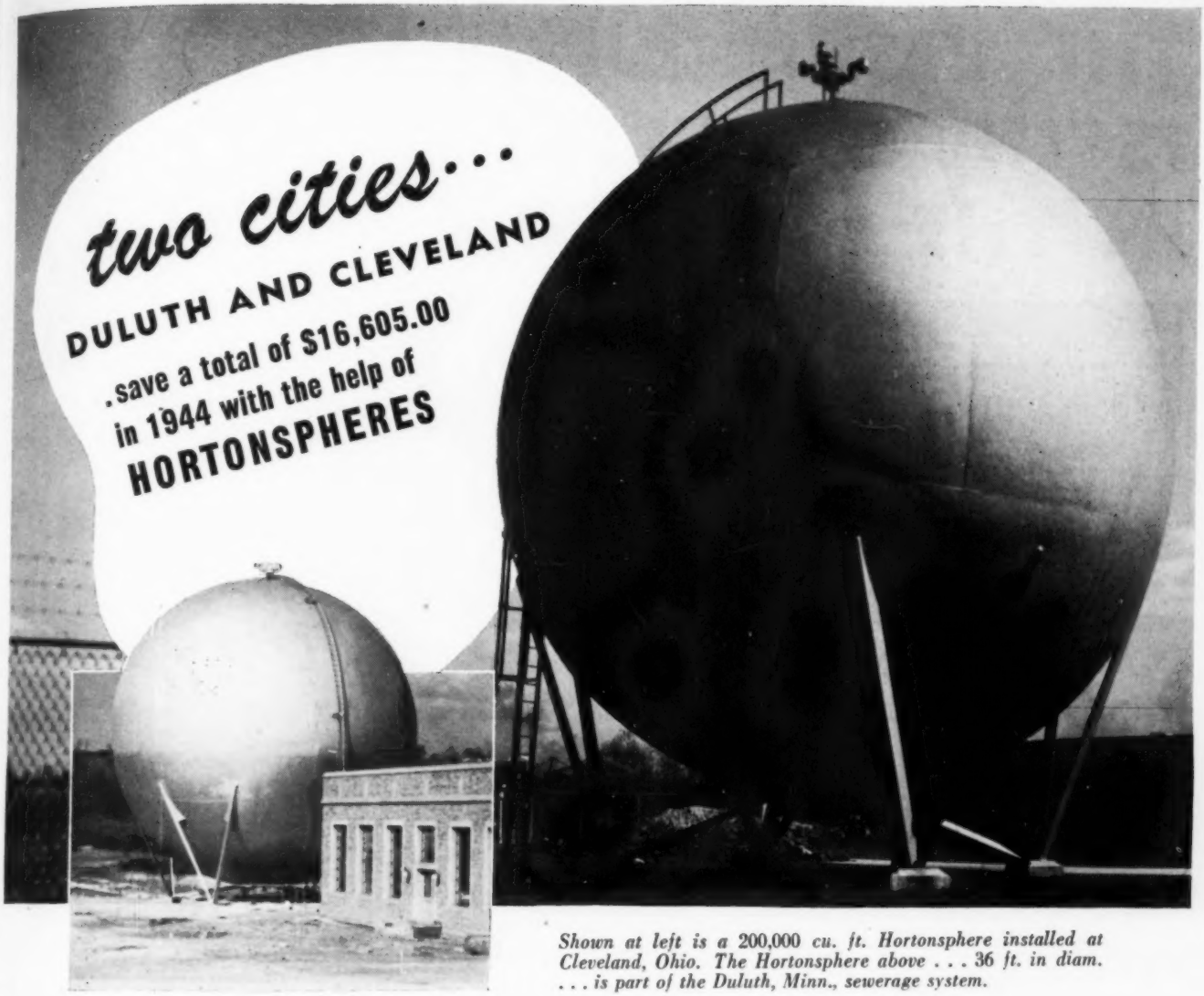

Shown at left is a 200,000 cu. ft. Hortonsphere installed at Cleveland, Ohio. The Hortonsphere above . . . 36 ft. in diam. . . . is part of the Duluth, Minn., sewerage system.

THE utilization of sewage gas as fuel to operate gas engines and equipment at sewage disposal plants is a sound practice followed in wide-awake cities. Some, however, go one economy-wise step further . . . they store some of the gas that is produced when the digesters are being charged regularly, for use on the days when some of the digesters are down.

When the digesters at the Duluth, Minn. sewage disposal plant produce more gas than is consumed, the surplus is stored in a 36-ft. diameter Hortonsphere. The plant's main heating boiler and smaller units, the incinerator, hot water heater and laboratory, burn the gas produced in the digesters and stored in the sphere. Installed in 1940 as part of Duluth sewerage system serving 80,000 persons, the Hortonsphere helped to save $10,105.00 during the year of 1944.

An equally outstanding record of economy was enjoyed by the City of Cleveland, Ohio. Here, two Hortonspheres . . . one of 50,000 cu. ft. capacity and one of 200,000 cu. ft. . . . helped to save $6,500.00 during 1944. Cleveland's digesters are charged only six days of the week. This means a drop in gas production for the seventh day.

Without proper storage facilities, it would be necessary to purchase gas to start the regular work week. The Hortonspheres, however . . . by providing safe, high-pressure gas storage . . . eliminate the need of purchasing fuel by making available, at all times, an adequate supply of gas for heating boilers, engines and incinerators.

If you do not store sewage gas at your disposal plant, or if your present facilities are inadequate, why not get an estimate of the cost of installing a Hortonsphere? State location, capacity and operating pressure desired.

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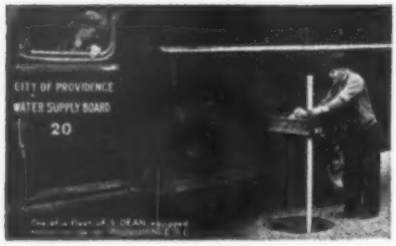
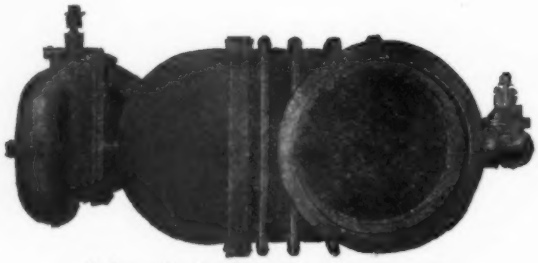


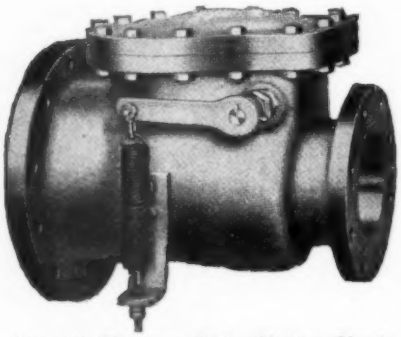
Dean Valve Closing Device from power take-off



Valve with Bevel Gearing, grease case and by-pass

Outside Screw and Yoke Valve

Tapping Sleeve and Valve



List 430 Clearway Quiet Closing Check Valve

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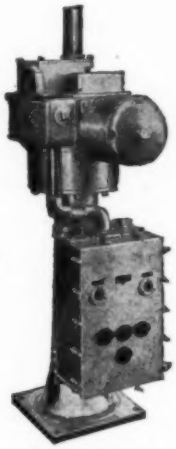

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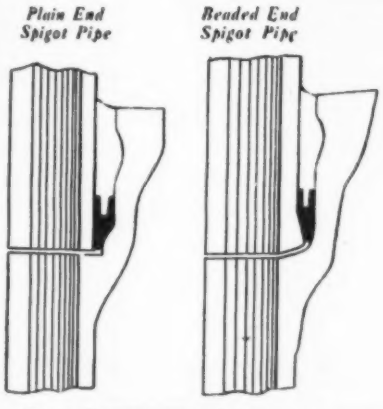

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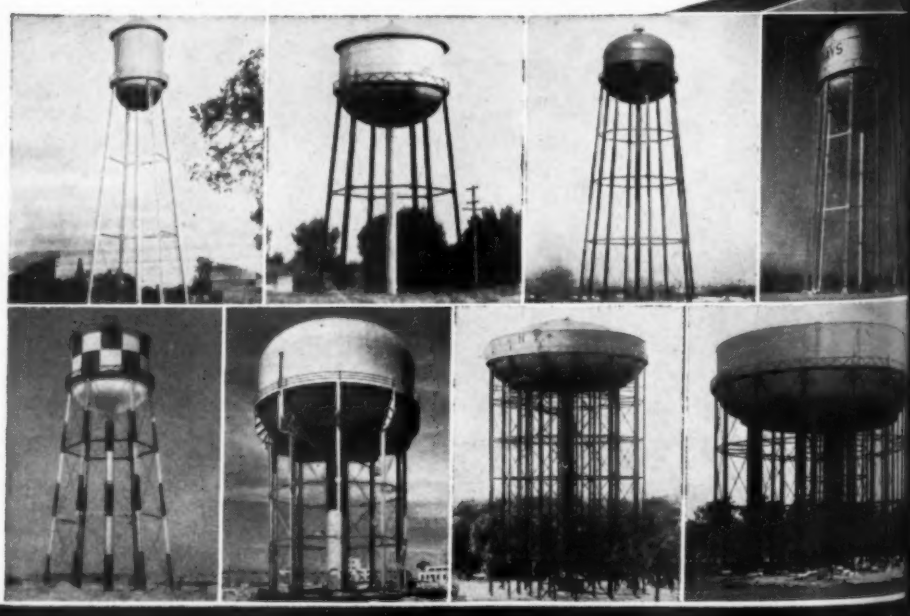

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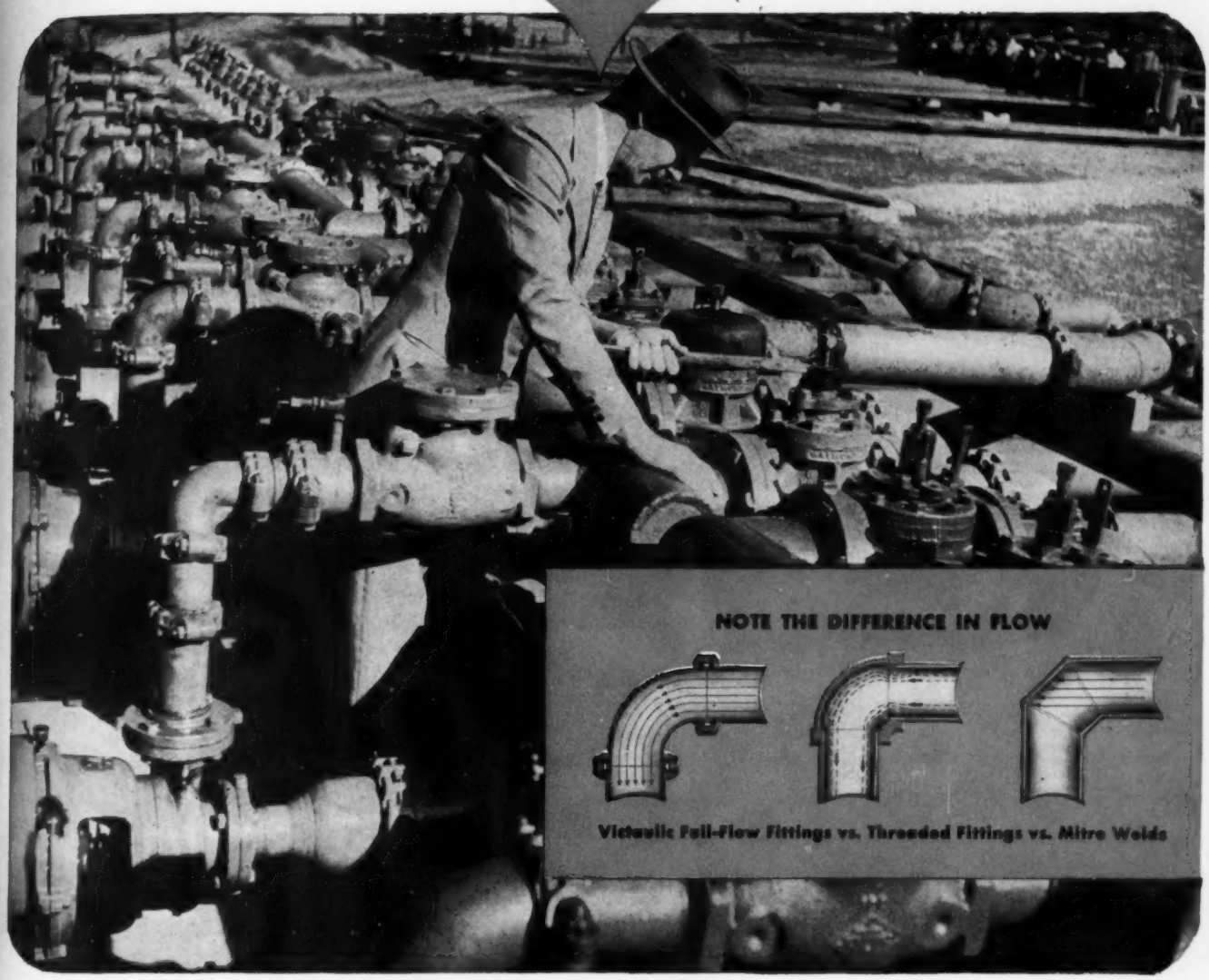

Victaulic Full-Flow Fittings and Couplings prove their greater economy at the Standard Terminal and Bulk Plant, Friendship, N. C.—Standard Oil Company (N.J.) photo.

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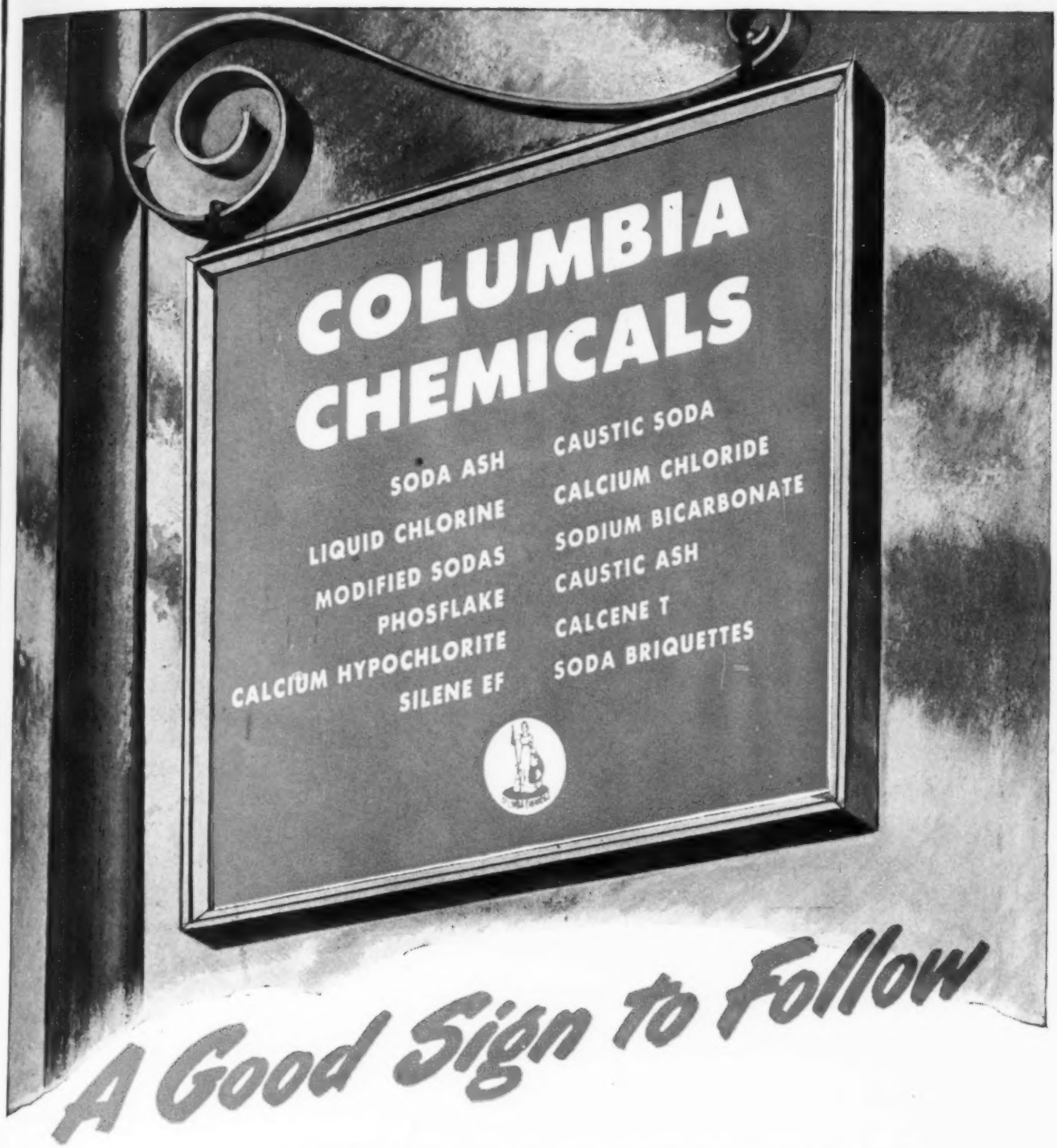

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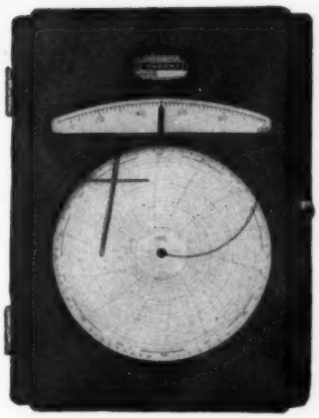

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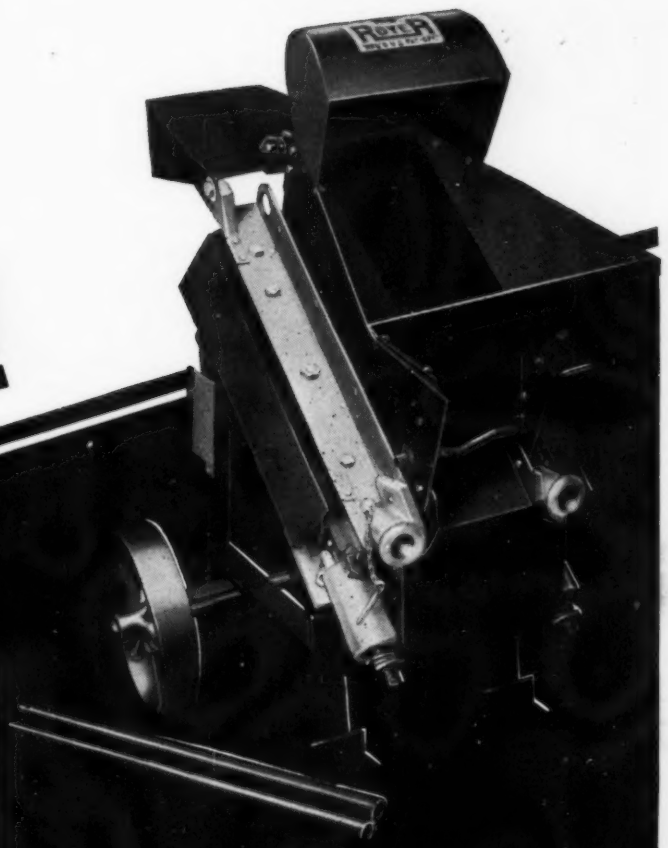

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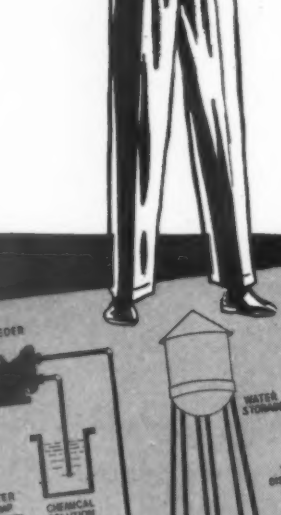

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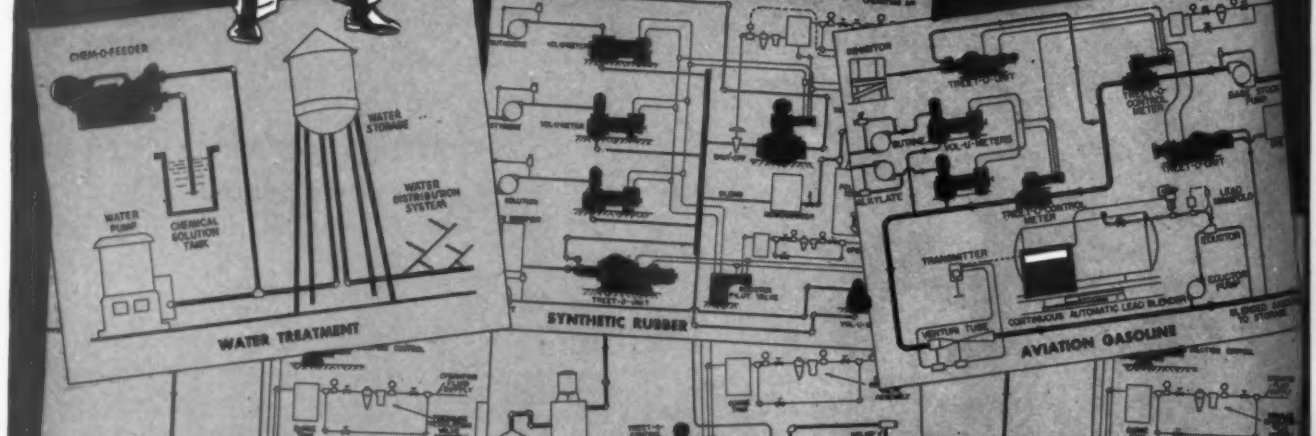

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155 East 44th Street, New York, N. Y.
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COMING!

Reforestation

Reforestation of watersheds as post-war projects appeals to us as a consideration of the first order. With this in mind we have been fortunate in securing an article from a water works manager of long experience with watershed reforestation. This article is designed to give readers of *Water Works and Sewerage* the know-how in developing and carrying forward reforestation work from the first land survey and selection of planning stock, through the planting and subsequent care of the planted area. Nursery preparation and operating procedure are also given for the benefit of those who may desire to develop their own nursery for a continuing planting program. Naturally, required equipment and organization as well as program costs are also discussed. The author of the Akron story, based on some years of experience, is—

WENDELL R. LA DUE,* Chief Engr. & Supt.,
Dept. of Water and Sewerage, Akron, Ohio.
*(*Vice-Pres.-Elect of A.W.W.A.)*

Trenching—In Earth; in Rock

One of our good subscribers has pointed out that *Water Works & Sewerage* has published little or nothing in recent years concerning modern methods of trenching in earth or in rock. So we now have something to offer in this category—one article devoted to "Earth Trenching" and a second devoted to "Rock Trenching." These articles have been written by our good friend and valued contributor—

RICHARD BENNETT, City Engr.,
Phoenix, Ariz.

What Water Metering Means to a Community

A pioneering water works engineer in South American countries has written for us an article answering the question: "Why should water supply be metered?" This article, originally in Spanish, was prepared at our request for inclusion in our forthcoming *Manual de Ingeneria Sanataria*, which is to be the Latin-American counterpart of our annual Reference and Data Number. The article contains so many fundamental arguments and concepts in water metering, that we have had it translated for printing in an early issue of *Waterworks & Sewerage*. The author, who happens to have been a former boss of Ye Ed's while in Panama, is—

DR. GEORGE C. BUNKER, Consltg. Engr.,
Nat'l. Inst. of Sanitary Works, Caracas, Venezuela.

Corrosion Control in Potable Water Systems

Is often misunderstood or so completely involved in theory and equations that it is practically unintelligible to the average water works man. It is, therefore, a pleasure to have an article on the subject, in which temperature, dissolved oxygen, films, silicates, phosphates, inhibitors, and proportional feeding of corrosion control chemicals are discussed simply and lucidly but without the loss of fundamental concepts. This presentation comes from—

ROLF ELIASSEN, Major,
Corps of Engineers, Ft. Douglas, Utah.

Lubricated Plug Valves vs. Gate Valves in Sewage Works

Is one man's opinion of when each of these types of valves should be used, and the problems each presents in a sewage works. That "one man" with considerable experience is

E. A. LOCKE, Ass't Engr. in Chg.,
Sewage Treatment Works, Hartford, Conn.

Build Your Own—Alum Solution Control

Is another in a series of successful gadgets developed at the Baltimore Filtration Plant. The describer is

A. A. BAILEY,
Filtration Engineer, Baltimore, Md.

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Offers an excellent means of handling wastes from laundries, scouring establishments, and synthetic rubber plants employing soap solutions. Experimental data on the application of calcium and magnesium salts to the treatment of such wastes have been obtained and reported by—

HARRY W. GEHM, Tech. Advisor,
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SHAKESPEARE

4 BILLION gallons of Water a day Wasted!

THE Water Plants of this country are needlessly pumping a combined total of FOUR BILLION gallons of water per day, most of which could be saved, if unaccounted-for leakage or waste was brought under good economic control. It is a financial problem . . . and *a national problem when it comes to the war effort.*

Consider the total amount of chlorine and coal that is needlessly used DAILY to treat and to pump this tremendous DAILY wasted gallonage. If all public water supply systems were to make an effort to reduce unaccounted-for water you can imagine the total possible saving of essential war materials.

Such a program will not only greatly help the War effort . . . reports from numerous cities show that it will result in increased revenue, through a better accounting for water pumped into the distribution system. Records prove that one of the most effective ways to minimize needless pumpage is systematic inspection, testing and repairing of water meters, especially the smaller sizes which have been in "operation" without attention for a number of years.

Your Trident representative will be glad to help you start a meter testing and repair program.

123

Reduce Water Waste

WITH BETTER WATER METER TESTING AND REPAIRING

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

WATER WORKS & SEWERAGE

VOL. 92, No. 5 *A Gillette Publication* MAY, 1945

WHAT WAR-TIME METERING HAS MEANT TO NAUGATUCK

A Threatened Water Shortage Averted, and One-time Waste Now Important Supply to Top-Flight War Industry

By WILLIAM H. MOODY
President and General Manager,
Naugatuck Water Co.
NAUGATUCK, CONN.

NAUGATUCK is a town located in the southwest section of Connecticut, with a population of 15,000 inhabitants. It is an industrial community and its principal products in normal times consist of waterproof footwear, canvas rubber soled shoes, reclaimed rubber, chemicals, malleable iron and brass products. At the present time, however, most of Naugatuck's industrial facilities are being used for the production of essential war products including bullet-proof fuel tanks for airplanes, inflatable rubber boats, life saving suits, intricate airplane instruments, cartridge caps, iron and brass products for munitions, et cetera. Also, one of the important plants producing synthetic rubber in the country, so vital in this war period, is located here.

The Author

The Naugatuck Water Company, a privately owned company, chartered in 1887 by the Legislature of the State of Connecticut, has continuously furnished water to Naugatuck and parts of the surrounding towns for 55 years. During this period its gross income has grown from $2,000 per year (1889) to better than $100,000 annually.

There is a high and low pressure distribution system, each supplied by gravity from its own storage reservoir. A greater part of the water sheds are owned by the Company. The water is fairly soft, and the only treat-

The 560 M.G. Long Hill Reservoir of the Naugatuck Water Co. (Center) and Shore Line Views of Prospect Reservoir (Right and Left)

Meter No. STATEMENT Amount $

THE NAUGATUCK WATER COMPANY

250 MEADOW STREET
NAUGATUCK, CONN.
PAYABLE WITHIN FIFTEEN DAYS FROM DATE .....

Meter No.					
To	Meter Reading	Gal.			
From	Meter Reading	Gal.			
Water Used		Gal.			
Quarterly Minimum Charge	"Meter				
Balance Due on Previous Rentals					
	Total				

Meter Rate Schedule:

Meter Size	Quarterly Minimum Charge	When Quarterly Use of Water Is Less Than
⅝"	$2.70	6,900 Gallons
¾"	6.00	17,900 "
1"	9.00	28,700 "
1¼"	15.00	54,600 "
1½"	20.00	79,600 "
2"	30.00	139,200 "
3"	50.00	339,200 "
4"	75.00	589,200 "
6"	125.00	1,089,200 "

FIRST 6900 GALLONS OR LESS PER QUARTER	$2.70
NEXT 17,100 GALLONS PER 100 GALLONS	.03
NEXT 21,000 GALLONS PER 100 GALLONS	.025
NEXT 75,000 GALLONS PER 100 GALLONS	.02
NEXT 32,880,000 GALLONS PER 100 GALLONS	.01
ALL OVER 33,000,000 GALLONS PER 100 GALLONS	.006

Bill Form Instituted With Metering and Rates Developed

In addition to the above printed rates the following two have been established for industries now supplied:
8 in. meter—$225. Quarterly minimum charge—2,089,200 gals. allowed.
10 in. meter—$350. Quarterly minimum charge—3,339,200 gals. allowed.

ment is chlorination. The total storage amounts to 650,000,000 gallons and the distribution system consists of fifty-six miles of mains.

Consumption Reaches Limit of Watershed's Safe Yield

From 1934 to 1940 the consumption of water increased from 700,000,000 to 1,100,000,000 gallons. This consumption exceeds the safe yield of the reservoirs should there occur a series of dry years. As a result, the officials of the Company decided to take some action to prevent a threatened water shortage.

One solution of the problem was to increase the water storage and build a new supply main involving an expenditure of approximately $300,000. Such an expenditure would have necessitated a substantial increase in rates to give the Company a fair return on the additional investment. [The existing return amounted to approximately 3% on the invested capital of a group of Naugatuck citizens with a community interest exceeding that of profits.—Ed.]

Past experiences of the water supply industry indicated that a change from the practice of selling water by a fixture rate to sale by meter measurement had always been accompanied by a reduction in the amount of water required to supply the demand on the system. This occurs through the reduction of water waste, and leakage on customers' premises, and effects a postponement of the day when additional sources of supply have to be developed. All of the industries (then being supplied through 80 services) had been paying on a meter basis for a number of years. The remaining services, about 3,000 in number, furnishing water for domestic and commercial uses, paid for water and service on a fixture rate schedule. Therefore, the adoption of meters would have to be sold to the general public.

Metering the Sound Solution

A review of the two possible solutions disclosed that the cost per year to the water Utility—which, in turn, would have to be paid by the consumer—amounted, for increased supply facilities, to approximately $30,000 per year; and, for changing to universal metering, to $2.00 per meter or $6,000 per year. The officials of the Company, were aware that any change would, generally speaking, be unfavorably received by consumers; but, after considering all of the facts, they decided that to install meters on all services was the soundest solution from all angles.

A public hearing was held in the Town Hall at Naugatuck at which the proposal was discussed. Approval was given, after a public hearing by the Public Utilities Commission of the State of Connecticut, to abolish fixture rates for all customers and set up a schedule of meter rates providing a decreasing charge per unit of measure as the consumption of water increased, and providing, also, for a quarterly minimum charge.

The new rate schedule was designed to yield to the Company substantially the same amount of *net income from domestic and commercial accounts* as had been the case with the fixture rates, after giving effect to the nominal increase in expense which metering and meter maintenance entails. The meter rate was established on a tentative basis in the beginning, and subject to review at the end of a year's experience. Based on experience of the first year the rates were to be revised, if necessary, so that the net income to the Company from domestic and commercial water sales through the meters would be approximately the same as by the fixture rate schedule. The industrial meters were not considered, as the proposed meter rate did not materially affect the already metered large consumers.

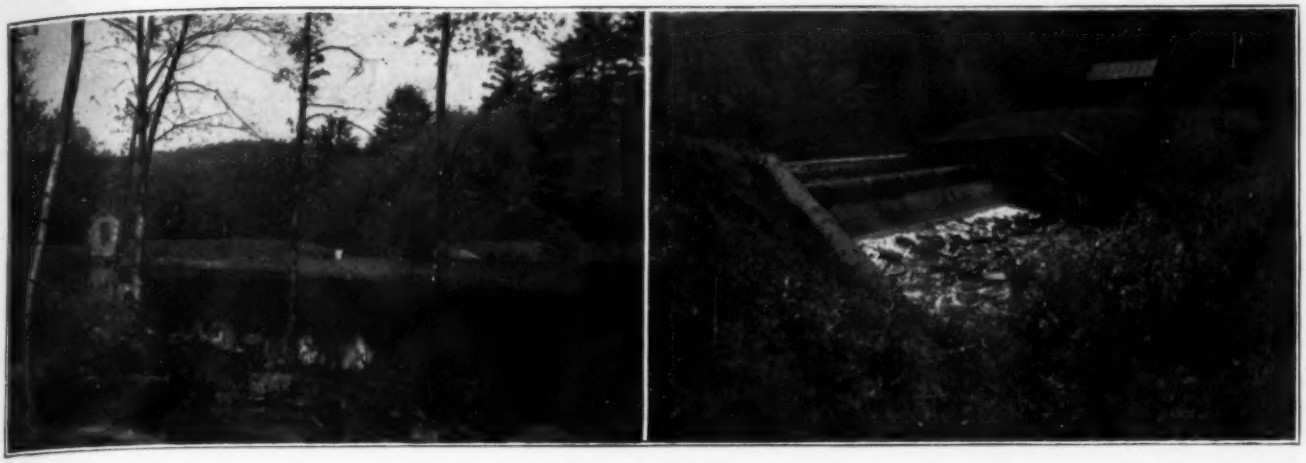
Selection of Meters

After investigation of the different makes of meters, disc type meters with the frost proof bottom feature were purchased for all services. The registers chosen were the *straight reading* variety. Also an important consideration to us was to have the measurement of water to the customer show *in gallons*, as this unit of measure would be familiar to all consumers, whereas the cubic foot measurement would have little or no meaning. [Furthermore, 100 gallons has the appearance of being considerably more than a mere 13.3 cu. ft.—Ed.]

The thought back of this reasoning was, also, that the customer could read his own meter at will and visualize the amount of water being supplied him for his money. He could also test the accuracy of the meter by drawing five or ten gallons of water and checking against the amount shown on the meter register. Meters were installed by our own workmen, and "copper-horns" were used for the setting of meters wherever possible. The cost of labor and material for setting each meter amounted to $3.10.

The New "Cash Registers" Watched Carefully

Meters were read at the end of each three month period and a comparison made of charges; that is, meter billings versus charges at the fixture rate schedule of the past. If a decided difference was noted in any particular bill, an investigation was made of the plumbing and as to number of occupants using the water service in question. Incidentally, leaks in the water closet valves accounted for most of the increase in water service cost to the customer through the meters as contrasted to the old fixture rate charges. Whenever a consumer was not convinced that leaks were the cause of his abnormal bill a recording "Meter Master" was installed and a record of flow into the premises over a twenty-four hour period usually proved the fact.



Naugatuck's Twitchell Reservoir and Spillway

(One of the small distributing reservoirs.)

More than six hundred such convincing recordings were made in one year as a great many buildings in the town, mostly tenement houses, had very poor plumbing.

In the test period, while customers were being shown that uncorrected leaks would be expensive, the fixture rate was kept in use. Then, after all meters were in service at least three months, the charges for water were put on the meter rate basis. Consumers, due to shortage of plumbers, were allowed one year to correct leaks, and when leaks were repaired, the water bills were credited with the computed cost of the water which had been running to waste before correction. In practically every case where water bills had been excessive, this procedure served to satisfy the customers complaining of the greater cost of water through the meters. The Company made every effort to make the change-over with as little friction as possible and, while the early cost was considerable, it paid dividends in improved public relations. In any event the water found to be wasting would not have been paid for under the fixture rate method, so there was no actual income loss in adjusting the high meter bills.

After the meters were in service for six months, it was apparent that the tentative rate could be and was lowered. Then, after an audit of the Company's accounts one year later, a final downward adjustment of the rate was made the subject of a public hearing by the Public Utilities Commission. This additional adjustment was made by making the final (lower) meter rate retroactive, and crediting customers' accounts accordingly. The final meter rate schedule, as reproduced with this article, gave to the Company the same net income from domestic and commercial accounts as would have been received by the fixture rate schedule—just as was originally planned. In considering the method, it was fortunate that an original meter rate was selected which would permit downward adjustments and credits to the customer, rather than the reverse which would have been extremely unfortunate.

60% Reduction in Water Requirement First Year

The saving in domestic consumption of water for the year following the installation of meters, as compared with the year previous when the fixture rate schedules were in effect, amounted to 284,000,000 gallons, or a saving of approximately 60 per cent. This gratifying attainment was realized even during the year when leakage was still a factor until corrections had been gradually made.

In addition to the advantages mentioned in the foregoing, the total consumption as shown by the new meters was checked against total water entering the system, as registered by the master Venturi meter.

After meters were in service one year, unaccounted for water, on the basis of such comparison, amounted to 25%. As a result of a Pitometer survey, it was discovered that there were numerous small leaks in the mains and service pipes. It was also discovered that unmetered consumption of water by industries amounted to 245,000 gallons per day. Additional meters have now been installed to correct the use of unmetered water, and leaks have been located and repaired. The unaccounted for water this year (1945) should be in line with other well metered and well maintained water systems.

Reading, Billing and Maintenance System

The town was divided into three districts for meter reading and accounting purposes, with approximately an equal number of domestic and commercial services in each district. Each district was divided into nine routes consisting of about 110 consumers per route. Meters in each district are read every three months in consecutive order, and bills are rendered accordingly. One meter reader is employed nine days of each month reading meters—the remainder of his time being devoted to testing and repairing meters and various other duties. This procedure effects a fairly even spread of accounting and billing work in the office. Consumers' accounts are posted on a Kardex System. A visible index is used for locating accounts, each account having a folio number and individual number. This system has proved very satisfactory as it eliminates congestion in office work and lessens the number of employees required. The income to the Company from billings and collections is approximately equal each month. Industrial meters are read each month and billed every three months.

In Summary

Summarizing the above—the change to universal metering by the Naugatuck Water Co. has proved very satisfactory—the actual amount of water saved having exceeded our expectancy. The decreased consumption by domestic users has made available an additional large amount of water, now being used to manufacture war products. A shortage of water in Naugatuck was, undoubtedly, averted during the past two summer seasons when the rainfall was considerably below normal. Unaccounted for water (wasted water largely) which was detected by universal metering in Naugatuck has been located and eliminated. The consumers —some of whom did not take kindly to the change—now appear to be satisfied that the meter rate is equitable and that payment by measurement is the only fair way to pay for water, just as it is for electricity, gas or any other commodity.

TEXAS SHORT-SCHOOL AWARDS

ANNUALLY the Texas Water Works & Sewerage Short-School makes a praiseworthy practice of giving "credit to whom credit is due." This takes the form of making awards to those who have made the greatest plant improvements during the year; those who have most effectively operated and maintained their plants to produce effluents of consistently high quality; those providing the most satisfactory laboratory control; and also for other attributes, such as plant beautification and maintenance.

Just how the plants are rated is not entirely clear to us, but there can be little doubt but that those voted the several awards by the Short-Schools' Committee on Awards are chosen on the basis of records and evaluations made by the Texas State Dept. of Health. One very interesting aspect of the presentation of the awards is the fact that the State Health Officer of Texas comes to the Short-School for the purpose of announcing the award winners and making the presentations, which carry a greater significance, thereby.

It is with considerable regret that circumstances prevented us from attending this outstanding Texas Water and Sewerage Short-School which has a record attendance of more than 400. In lieu of our ability to give to our readers a full account of the 1945 School we are presenting herewith a group of pictures showing several of the award winners. In addition to those pictured the following awards were also announced for the year 1944.

Award to—	For—
Mission	Highest per cent of population connected to the public water system.
Jacksboro	Best bacterial analysis record.
Jacksonville	Maintaining best water control laboratory.
Brady	Highest per cent of population connected to sewer system.
Camp Swift	Maintaining most attractive sewage plant.
No. Am. Aviation Corp.	Maintaining best sewage plant control laboratory.
Lubbock	Best method of sewage sludge disposal and use.
Big Spring	Most advantageous use of sewage effluent for industrial purposes.
Uvalde	The same for irrigation uses.

W. N. Joiner, Supt. at San Marcos, Tex. was chosen President of the Short-School succeeding W. F. Hicks, City Engr. of Paris, Tex. who was awarded the customary "Certificate of Texas Citizenship" to the retiring president.

(For the snapshots used with this account we are indebted to V. M. Ehlers, Short-School Director, and Wm. E. ("Bill") Pebworth, S. W. Mgr., Hersey Meter Co., Dallas, who took the pictures.—Ed.)

Uel Stephens, Supt. Water & Sewerage, Ft. Worth, Tex.
(Chairman of the Awards Committee)

Dr. Geo. W. Cox, State Health Officer, Austin, Tex.
(Principal speaker, who announced award winners)

W. E. Beaty, Supt., West Texas Utilities Co., San Angelo, Texas
(Recipient of award for maintaining the most attractive plant in the state)

E. J. Umbenhauer, Supt. Water & Sewerage, El Paso, Texas
(Recipient of award to that water utility completing greatest improvements to its purification plant.)

J. B. Massa, Supt. Water & Sewerage, Pampa, Tex.—behind "mike" in first picture.
(Chairman, Panhandle Water and Sewerage Assn., accepted award for his group as winners of short-school attendance record for third successive year.)

Lt. Col. C. F. Evans, Army Air Field, Victoria, Tex.
(Recipient of award to that sewage treatment plant having consistently maintained best average effluent.)

J. S. Williams, Supt., West Columbia, Tex.
(Recipient of award to that community showing greatest ratio of new sewer connections made during year.)

S. C. Cooper, Supt. Water & Sewerage, Big Spring, Tex.
(Recipient of award to that city providing most noteworthy improvements to sewage treatment plant.)

CATHODIC PROTECTION OF STEEL SURFACES IN CONTACT WITH WATER

As Applied to Hot-Water Tanks, Clarifier Mechanisms, Deep Wells

(The Third of a Series of Articles)*

By LEE P. SUDRABIN
Chemical Engineer
ELECTRO RUST-PROOFING CORP.
DAYTON, OHIO

CATHODIC protection can be successfully applied to any steel structure submerged in natural water providing (a) the submerged surface contour of the structure lends itself to a practical anode design for proper current distribution and (b) an adequate current density is used to stifle the corrosion currents which flow through the corroding media between local areas of different potential on the surface of the unprotected metal. In addition to water storage tanks which are usually simple geometrical structures, cathodic protection is being used on other more complex structures in contact with natural waters. Amongst these are hot water tanks; clarifiers; deep well column pipe and well screens and casings; open tank condensers[1]; revolving screen frames; sludge blanket filtration and Zeolite type softeners; etc. The protection of pipelines in contact with corrosive soils by means of a current flow projected to the exposed metal surfaces is accepted practice by all the major oil and gas companies and some industrial and municipal water systems.[2,14] The rate of depreciation of many miles of pipeline, originally well covered with coal tar enamel or asphalt coating, where, after a few years, the number of leaks per mile occurring yearly, as a result of soil corrosion, often reached prodigious figures, has been reduced by the use of cathodic protection. A relatively small expenditure for a corrosion survey by an expert corrosion engineer, cathodic protection equipment and electrical energy, on a pipeline rendered nearly unserviceable because of soil corrosion, will reduce to reasonable limits the nuisance and loss from frequent leaks, and the need for ultimate relaying of all or a portion of the pipe line. The application of cathodic protection to sewage equipment is a relatively new field in which much work is under way as recorded by Parkes[3] and Kozma.[3a]

The Author

The Hot Water Corrosion Problem and Cathodic Protection Experiences

Hot water tanks, such as those used in domestic, institutional and industrial water systems, provide an excellent illustration of some of the corrosion fundamentals that must be considered in cathodic protection design. Frequently the only serious corrosion problem encountered in a municipal water system is that found in domestic and commercial hot water tanks. It has been reported that over 500,000 domestic hot water tanks are replaced yearly in the U. S. because of corrosion. It can be seen that because of the magnitude of the problem those responsible for water systems are actively seeking methods for alleviating this corrosion. Many methods of corrosion control for hot water tanks have been tried and adopted, amongst them are: use of inhibitors; controlled lime saturation; deaeration; linings of cement-mortar, glass enamels, or synthetic resin coatings; metallic coatings such as zinc, which often provide protection for a limited period only; and cathodic protection.

A general picture of the cause and characteristics of corrosion in hot water tanks using municipal water supplies may be obtained from a study of up-to-date power plant water conditioning practice. In order to prevent corrosion in a boiler feed water system, the water before passing through the piping and stage-heaters on its way to the boiler is usually deaerated in a mechanical degasifier where the water is exposed to favorable temperature and pressure conditions. Following this treatment sufficient sodium sulphite, or other oxygen scavenging chemical, is added to the water to reduce the traces of oxygen not removed by the deaerator. In spite of feedwater temperatures as high as 400° F., a pH as low as 6.5, the presence of dissimilar metals in heat exchangers, soluble salt concentrations ranging from 0.5-200 ppm. and the absence of scale forming salts or inhibitors, the corrosion or pitting rate in feedwater piping, heat exchangers and tanks in the feedwater system is negligible so long as *the dissolved oxygen is completely removed.* Since microorganisms can hardly contribute to the corrosion process in hot water tanks, and since other oxidizing agents or depolarizers usually are not present in appreciable amounts in municipal water supplies, it becomes apparent that the factor governing this corrosion process is the presence of dissolved oxygen. At the present time it does not appear generally feasible to deaerate water distributed in municipal water systems because of the cost of deaeration, the possibility of encouraging the growth of anaerobic microorganisms and degradation of organic matter in the mains, and the presence of a flat taste found in the water when the soluble gases other than dissolved oxygen have been removed.

In a sense cathodic protection may be likened to an electrolytic deoxygenation process concentrated immediately on the protected metal surface. This thought will be illustrated

[*The first and second articles of this series by Mr. Sudrabin appeared in *W. W. & S.* for January and February, 1945.]

later on in this paper by the reduction of the concentration of dissolved oxygen in the water leaving the hot water tank compared to that entering, and without any wastage of the steel tank being noted. Speller[4] has used the "oxygen drop method" as a direct measure of the amount of corrosion which has taken place in a natural water environment. By measuring the rate of flow and the decrease in oxygen content of the water leaving a certain section of the water system, against that of the water entering, the amount of corrosion attack occurring in the section can be closely predicted. When properly designed cathodic protection is applied there is no metal wastage of the steel tank corresponding to the oxygen drop. It is evident, therefore, that the oxygen has been reduced without the flow of local corrosion currents on the metal surface.

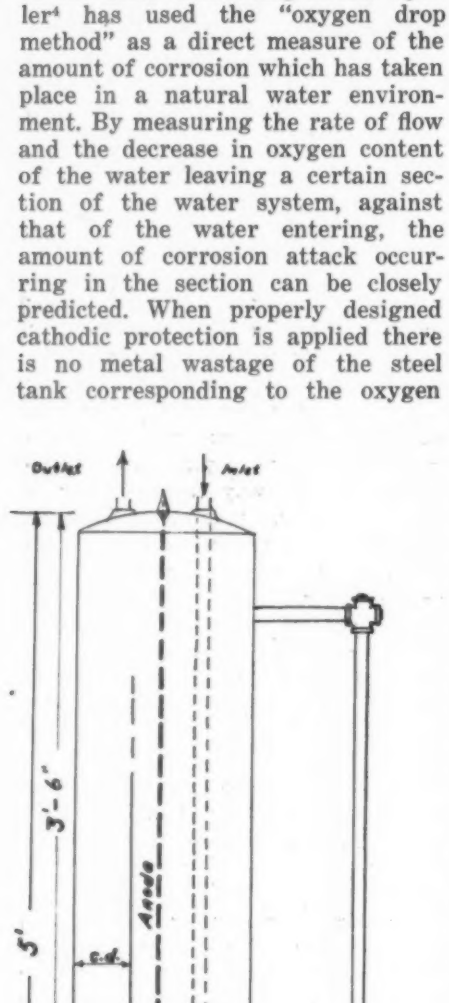


Fig. 1—Sectional Sketch of Cathodically Protected Domestic Hot-Water Tanks, Columbus, Ohio, Studies

(Adequate protection extended over the wall area below the terminal of the anode only for a distance of one-half the tank diameter—adequate proof of the need for effecting approximately equi-distant current travel from anode to the protected surfaces, if economically effective protection is to result.)

Columbus, Ohio, Experiments

During the past few years a number of hot water tank corrosion experiments have been conducted by C. P. Hoover[5] of Columbus, Ohio. Amongst these tests, the objective being an evaluation of the many methods of corrosion control, was the application of cathodic protection to two of the battery of 30 gallon domestic hot water tanks. One of these two tanks was fabricated of black iron, the other of galvanized iron. The cathodic protection equipment for these tests, which began on June 9, 1941, and were completed on June 9, 1943, was provided by the E.R.P. Corp. The tanks were operated during this interval at a temperature between 140°-150° F. with ten gallons of water being withdrawn from each tank three times daily the first year and twice daily during the second year of the test. Treated Columbus city water used in this test is usually close to saturation with oxygen and has a positive lime saturation index. In the cathodic protection 0.6 and 0.35 amperes were applied to the galvanized and black iron tanks respectively. Fig. 1 illustrates the anode position in respect to the tank. Average oxygen concentrations measured in the effluent of the galvanized and blackiron tanks were 1.9 ppm. and 2.4 ppm. respectively. At the end of two years the tanks were cut open and inspected. The observations made were very interesting. In both tanks protection was complete to within ½ tank diameter below the anode. The protected surfaces were covered with a hard thin scale having the following analyses:

Tank Deposit Composition

	Black Iron Tank	Galvanized Tank
SiO_2	3.9%	6.0%
Al_2O_3	4.7%	31.1%
Fe_2O_3	43.2%	10.4%
P_2O_5	0.3%	0.1%
CaO	14.6%	3.5%
MgO	8.1%	0.8%
ZnO	2.9%	30.2%
Ignition Loss—(CO_2)	11.0%	17.0%

Below this line of demarcation a few pits on the lower 12 inches and bottom of the tank were noted. On reexamining Fig. 1 the reason for this phenomenon can be discovered. The probable current density distribution along the wall of the tank is indicated by distance of the c.d. (current density) line from the wall of the tank. It will be noted that the current density on the tank wall below the electrode decreases rapidly until it is no longer adequate for complete protection. Even so, partial protection is received below the region where the minimum current density requirements are being provided. The walls opposite the electrode received a much higher current density than was actually required for complete protection.

Many objective studies of cathodic protection on practical applications such as this coupled with a basic background on the fundamentals of current density requirements and anode design now provide a more satisfactory treatment of this corrosion problem. For instance, the need for a longer electrode, to provide a more nearly uniform distance of current travel from anode to the surfaces requiring protection, was illustrated in this test. This case further illustrates the importance of providing the proper current distribution, which factor is influenced only by the potential relationships existing between the electrode configuration in the corroding media and the submerged surfaces of the structure being protected. It will be noted that neither galvanizing nor treatment productive of a scale forming water can be depended upon to provide adequate protection where dissolved oxygen is present. Most particularly is this fact evident where hot water corrosion is involved.

Public Service Electric & Gas Company

A cathodically protected 300 gal. hot water generating tank built of ¼ in. steel plate at the Kearney (N. J.) Generating Station of the Public Service Electric and Gas Co., has been previously reported upon by E. H. Thwaits[6,7] of the Am. Iron and Steel Institute. The present tank was installed in April, 1942, to replace a tank which had been patched repeatedly because of leaks developing after but fourteen months of operation. In the heater tank 13.5 square feet of copper steam heating coils which are insulated from the main body of the hot water tank are located near the bottom of the horizontal tank. The area of the coils are adequate to heat the volume of water contained within the tank from 60°F. to 180°F. in one hour. In the unprotected tank the pitting was found to be nodular at the top of the tank and, as the wall was examined from the top downwards, it was noted that the corrosion product oozing out of the lower nodular anodic

areas streamed down the tank wall like a veil. Under this veil of corrosion product, which masks the metal underneath from the dissolved oxygen in the water, further pitting action was initiated. When the veil-like corrosion product was removed from the wall, long finger-like pits are revealed. The greater intensity of corrosion noted near the top of the tank probably can be accounted for by turbulent effect created by the convection current rising from the heating coil striking the top and sweeping down each side of the tank.

The water heated in this tank is Wanaque Reservoir tap water having the following analysis:

Content	ppm.
Temporary Hardness	16.3
Permanent Hardness	11.1
Total Dissolved Solids	51.5
Suspended Matter	0.86
Silica	6.5
NaCl	6.0
M.O. Alkalinity	18.0
pH—(adjusted by treatment)	8.8

Starting April 1942, a c.d. of about 1 amp. per 2000 sq. ft. was applied to this tank and no leak had developed after about 22 months of operation. Although the progress of the corrosion process had been reduced below that which had been previously encountered, it was clear that corrosion had not been completely stopped as evidenced by the continued formation of rust and the presence of pits. In January, 1944, the current density was increased to 1 amp. per 750 sq. ft., but it was simultaneously revealed through research then being conducted at the Westport Mill of the Dorr Co. that even a higher c.d. requirement was indicated for this tank. In the spring of 1944 a larger rectifier was supplied in consequence, and a current density of 1 amp. per 35 sq. ft. (2.86 amps./100 sq. ft.) was applied.

Three months later, upon re-examining the tank, the corrosion product was entirely removed and the surface of the tank was found to be coated with a light powdery-like deposit. The absence of active attack was striking. In December, 1944, the current density was reduced to 1 amp. per 70 sq. ft. (1.43 amps./100 sq. ft.), and in view of the particular corrosion environment it is the author's opinion that this c.d. will provide satisfactory protection. Tests made of the oxygen content of the water entering and leaving the tank were as follows:

Water entering tank—
13.95 ppm. O_2

Water leaving tank—
5.85 ppm. O_2

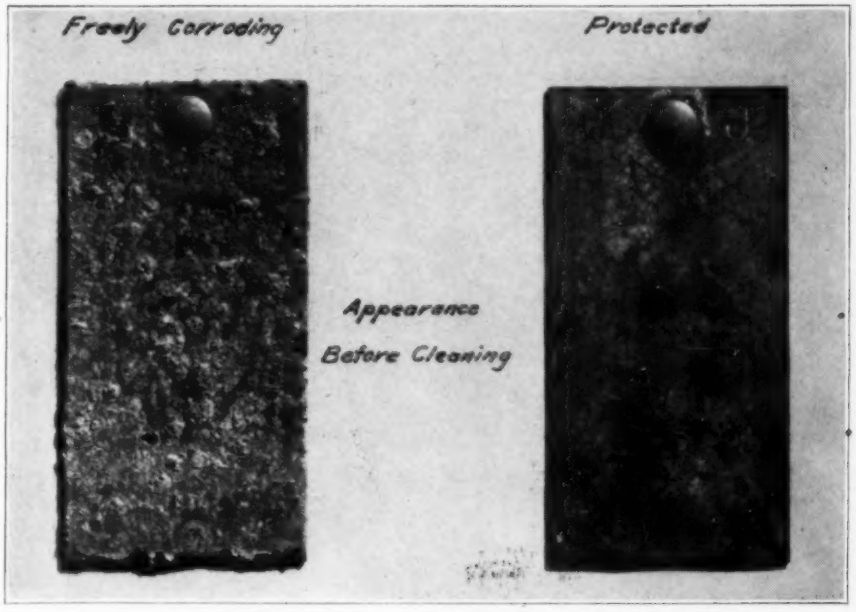


Fig. 2—Freely Corroding and Cathodically Protected Test Specimens from a Clarifier

(This illustration used with the initial article of this series reveals the type of attack (upper left) observed in a clarifier handling a lime treated oxygen saturated water, possessing a positive Carbonate Saturation Index. The upper right specimen was cathodically protected and suffered no attack.)

Therefore, the reduction of dissolved oxygen content of the water occurring in a tank was 8.10 ppm.

Discussion

In the absence of cathodic protection the actual metal wastage from the tank walls could be predicted from a consideration of the amount of water withdrawn and the reduction of the dissolved oxygen content occurring within the tank. For example, the reduction of 8.10 ppm. of dissolved oxygen in 300 gallons of water passing through the tank would represent the degradation of about 21.4 grams of metallic iron from the tank wall, this iron being converted to ferric hydroxide.

The dissolved oxygen in the raw water entering a pressure type of heater will remain in solution except for that which is reduced by the natural corrosion currents (or by the projected current where cathodic protection is applied) since the pressure within the heater will not permit the release and removal of the dissolved gases from the water to the atmosphere.

The current density required to protect an open type hot water heater is usually much less than that required to protect a pressure type of heater. The reason for this will be clearer when it is remembered that the solubility of oxygen and other gases in water at atmospheric pressure decrease with increasing temperature. Therefore, in an open type heater which is usually vented to the atmosphere the gases are gradually evolved until they are almost entirely removed at the boiling point. Under conditions where the incoming water is saturated with oxygen it can be seen that the oxygen will remain in the water in a pressure heater whereas in an open type heater a large portion of these gases would be vented to the atmosphere. The heated water thus becomes progressively less corrosive.

Since, it has been previously shown that with all other conditions equal the current density requirements vary with the dissolved oxygen concentration of the water, it becomes apparent that an open type heater will require a lower c.d. than a pressure type heater employed to heat the same water.

New York Central Railroad

A cathodic protection installation in an open type heater at the Harmon, N. Y. Yards of the New York Central Railroad has been recently described by E. H. Thwaits.[6] A live steam jet was used to heat the water. It is apparent the live steam used for heating would strip most of the dissolved gases including oxygen from the water and, therefore, require a low c.d. for protection of the steel tank. Actually, a c.d. of 1 amp./1280 sq. ft. proved adequate for protecting this tank.

Fig. 3—Metal Work of Sludge Blanket Up-flow Type of Water Softening Tank

(Tuberculation, and pitting beneath these tubercules proceed despite a lime treated depositing water which has not prevented dissolved oxygen attack.)

Well Pump Corrosion and Cathodic Protection Experiences

The corrosion occurring on the casings, screens and pumping equipment used in deep wells offers a tantalizing problem to those interested in cathodic protection. The failure of the well casing and screen by corrosion usually necessitates the drilling of a new well. Corrosion occurring in the pump bowl, impeller, column pipe and shaft tubing often causes the pump to be pulled prematurely for replacement or repair of the affected parts. There are two types of corrosion currents which influence the attack on deep well equipment. The first is the local corrosion cell type of attack discussed in the author's preceding articles. The second is the man or mechanically created corrosion current which is covered by the broad term—electrolysis. The latter is occasionally found where nearby DC power systems are grounded and current is forced to flow through the water or soil around poorly connected metal joints within the well or to flow from the well through the soil to some adjacent structure possessing a lower potential. Some thought has also been given to the possibility of a rotating pump shaft cutting magnetic lines of force generating direct current which would flow through the shaft and return through the column pipe, etc.

Electrolysis can usually be overcome by a complete survey of the electrical environment surrounding a well and then providing measures indicated by the survey to prevent the forced drainage of current from any metal surface in the well. The local corrosion current cells on the metal surface can be stifled by a projected current from properly positioned anodes within the annular space between the shaft and the column pipe and between the column pipe and the well casing. Other electrodes can be positioned to provide a protective current flow to the inner surfaces of the casing and screen below the pump suction. The corrosion cells caused by dissimilar metals are stifled by cathodic protection. The outside of the casing may be protected against soil corrosion by projecting a current flow through the soil to these surfaces. In view of the complex nature of the interior of the pump bowl and impeller the author does not at this juncture feel that these intricate surfaces can be reached by projected current flow from any practical anode design. This part of the well can best be fabricated of corrosion resistant metals.

Application Experiences

F. P. Macdonald[8] has discussed an oil lubricated deep well turbine pump at La Peer, Michigan, whose column pipe was severely pitted when pulled and examined in 1941 after eighteen months of operation. At that time the column pipe was renewed and cathodic protection was applied. Upon re-examining the column pipe after 31 months of operation there was no evidence of attack occurring during that interval. Four other cathodic protection installations in deep wells have been made in Indiana, Louisiana and British Guiana. While these installations are being carefully followed it is yet too early to justify any statement.

Clarifiers and Sludge Blanket Filtration Devices

An unexpected corrosion problem being discovered in most water plants treating raw surface water is the attack of clarifier mechanisms and of the sludge blanket filtration type softeners. This attack is usually not anticipated since in the softening process the water is treated with lime and generally has $CaCO_3$ depositing properties which have been assumed to provide protective properties to submerged steel surfaces. In spite of the positive $CaCO_3$ Saturation Index the corrosion process is active in the presence of such aerated treated water. The freely corroding test specimens shown in Fig. 2 from the first article of this series in the January issue of this magazine illustrates the type of attack occurring on a water clarifier mechanism in Ohio. The cathodically protected specimens supported against the mechanism structure, shown in the same photograph, were completely protected without any corrosion or pits developing during the interval of the test.

An illustration of the type of attack occurring on the submerged surfaces of the Sludge Blanket Filtration type of softener is shown in Fig. 3. The nodular formation of corrosion product (tuberculation) lies over the anodic areas where pitting has progressed beneath these nodules—in a few places even completely through the steel sheet baffles. Cathodic protection is now being applied to many clarifier mechanisms and Sludge Blanket Filtration Type Softeners with very encouraging results.

Dangers in Cathodic Protection Are Few But Require Consideration

The possibility of deleterious effects resulting from properly designed cathodic protection is negligible. It has already been stated in the author's first article (*W.W.&S.*, January, 1945) that an excessive current density will not prove to be harmful to iron. A design consideration that must be made in any cathodic protection installation is the provision for a continuous low resistance path back to the rectifier from all submerged surfaces receiving a protective current flow. The importance of this is illustrated by the corrosion induced on a poorly bonded pipe joint when current is flowing through the pipe. A portion of the current will leave the pipe and flow through the electrolyte to the adjoining pipe section around the resistance at the joint. Corrosion attack is induced at the pipe joint where the current enters the electrolyte. Whereas the adjoining pipe section receiving the same current flow from the electrolyte is being protected. Eliassen and Goldsmith[9] have shown under controlled conditions that the grounding of 1.25 amperes of either alternating or direct current at one end of a length of ¾ inch pipe and the drainage of this current from the other end of the pipe had no appreciable effect on the quality of the water passing through the pipe. This would indicate that a good current drainage path back to the rectifier from the structure being protected will not influence the normal corrosion processes occurring on surfaces which do not receive a projected current through the corroding media to the metal surface.

Cathodic Protection Literature

Although the fundamental principles of cathodic protection have been well understood for many years and are available in the corrosion literature, the water works field has been fortunate in having had the application of this method of corrosion control to water plant equipment studied and discussed by O'Brien,[10] Mabee,[11] Norman,[12] Knudsen,[2] Keith,[13] Schneider,[14] and by numerous others who have not published their findings. Their observations have contributed much to the better understanding of cathodic protection amongst the men who must battle corrosion in the water and sewage works field.

Conclusions

The application of cathodic protection frequently presents a complex engineering design problem, not fully appreciated by many. And, for truly successful results and economy, a comprehensive survey of the corrosion environment is the only recommended procedure, except in the simplest cases wherein success seems almost automatic.

Any steel surface submerged in natural waters can be protected when an adequate current density, projected from a properly designed anode configuration within the corroding media (and this is of highest importance) is properly distributed so as to stifle the corrosion currents flowing between local cells on the metal surface requiring protection.

All other conditions being equal, the current density requirements for complete protection are a function of the dissolved oxygen content of the water, temperature and velocity.

The deposition of $CaCO_3$, or the existence of other relatively continuous protective coatings on the metal surface, will reduce current density requirements for complete protection.

In regions where ice formation occurs in tanks there is a "corroding season" and an "inactive season." The "corroding season" occurs during the months when the metal is in contact with water, whereas the "inactive season" is the period where the metal surface is protected by an ice film barrier. Protection must be provided during the "corroding season."

Bibliography

(1) Miller, N. A., *Refiner Gas Mfgr.*, 20, 237-41, 1941.
(2) Knudsen, H. A., *Jour. AWWA*, 30, No. 1, 38-55, 1938.
(3) Parkes, G. A., *Waterworks and Sewerage*, 88, No. 3, 99-105, 1941.
(3a) Kozma, A. B., *Waterworks and Sewerage*,, April, 1945.
(4) Speller, F. N., "Corrosion Causes and Prevention," Pg. 232, 2nd Ed., McGraw-Hill Book Co., 1935.
(5) Hoover, C. P., Annual Report, Div. of Water, Columbus, O., 1943.
(6) Thwaits, E. H., Discussion of Paper by L. P. Sudrabin presented at 5th Annual Water Conf., Engrs. Society of Western Pennsylvania.
(7) Thwaits, E. H., Amer. Iron & Steel Institute Report on Cathodic Protection of Hot Water Tanks and Piping.
(8) Macdonald, F. P., Discussion of Paper by Larsen, T. E., and Millis, J. B., *Jour. AWWA*, 36, No. 8, 886-94, 1944.
(9) Eliassen, R., and Goldsmith, P., *Jour. AWWA*, 36, No. 5, 563-76, 1944.
(10) O'Brien, G. L., *Water Works and Sewerage*, July, 1942.
(11) Mabee, W. C., *JAWWA*, Vol. 32, No. 7, 1075-7, 1940.
(12) Norman, E. E., *JAWWA*, Vol. 32, No. 7, 1069-74, 1940.
(13) Keith, J. Clark, *Water and Sewage*, July, 1941.
(14) Schneider, W. R., *Gas*, 15, 17-21, 1939.

Coagulation Kink*

The water supply of the Interstate Water Co. is taken from a small river which flows through the plains of Illinois, and winds its way through shale beds not far above the intake for the water plant. The impounding dam at the water plant backs the water up to a level which brings the water surface to the outcroppings of soft shale.

It had been noticed that, even when there was no rain, the water in the impounded reservoir would suddenly become milky with a turbidity that was almost impossible to remove. These occurrences were concurrent with winds which caused the water to lap the shale beds. It mattered little the direction of the wind, because the river reversed itself many times, and shale was exposed in almost every direction.

To study this particularly difficult turbidity, the writer built an experimental glass filter in proportion to the regular filters, and made experiments. The best coagulating reagent was found to be yellow clay which also occurred on the slopes of the hills surrounding the river banks.

Thereafter, this particular trouble was overcome by suspending two gunny sacks filled with yellow clay, in the mixing chamber. The amount of clay which would wash out of the sacks with the passage of water was sufficient to act as a coagulating aid. It then became obvious that when the river water was turbid following heavy rains, the clay which washed into the reservoir from the hills was a natural coagulant for the colloidal shale which would also be washed in at the same time.

It was also observed, in those early experiments many years ago, that yellow clay acted to remove colloidal color caused by the leeching by winter snows on the farm lands of the drainage basin.

With the advent of Nuchar activated carbon, and its adoption at the Danville Plant, the need for yellow clay as a coagulation aid or color remover was dispensed with; but we know that, should we ever run short of this commercial product when there exists color or colloidal turbidity to remove, we have a handy reagent "in our own back yard".

*Contributed by Martin M. Symons, late Chief Engineer, Interstate Water Co., Danville, Ill.

ON BLUEPRINTING NOW!

Useful Check Lists for Water Works and Sewerage Executives

AT this time when the European fight is all but over, and many war veterans will be returning home, this matter of "Blueprint Now!" must shortly be that of do something now. It therefore seems timely to reproduce the two suggestive check lists, developed by the Joint Committee on Water and Sewage Works Development, as guides to water and sewage works executives in an effort to indicate the many potential improvements and likely needs of water and sewerage works systems which have now overly long been operated with skeletonized or essential maintenance only.

To develop post-war programs but little time remains if the projects are to have any real value in supplying employment for service men released as soon as Germany's surrender is accepted. Water and sewerage works executives should therefore find it helpful to once more examine the two lists of suggested betterments for consideration reproduced herewith.

A Check List for the Water Works Executive

General

1. Quantity—Raw Water
(a) Is supply ample for general domestic and ordinary industrial requirements NOW?
(b) Have drought periods caused curtailment?
(c) Is supply expected to be sufficient for the demands of the next 10 yrs.?
2. Quality—Raw Water
(a) Is watershed relatively clean?
(b) Is pollutional load slight?
(c) Is pollutional load heavy?
Industrial wastes
Sewage
(d) Are chemical characteristics:
Soft (below 100 ppm.)
Hard
Highly colored
Corrosive?
(e) Are algae growths a problem?
3. Sanitary Control
Does water utility control:
Watershed
Shore line
Uses of impounded waters?

Source of Supply

1. Creek or River (Surface Supply)
(a) Quantity
Is runoff becoming more "flashy"?
Is channel or other storage necessary?
Is ice formation a problem?
Are low water periods becoming longer?
Are discharge measurements kept?
Do flood control impoundings regulate stream flow?
(b) Quality
Are chemical characteristics changing?
Are high turbidities a problem?
Are industrial wastes affecting operation?
Is bacterial load increasing?
2. Lake or Impounded Supply
(a) Quantity
Has level been receding for some years?
Has silting reduced capacity?
Is runoff into lake diminishing?
Are rainfall and lake level records kept?
(b) Quality
Are algae growths troublesome?
Is lake shore owned by city?
Are industrial wastes in watershed controlled by city?
3. Well or Spring Supplies
(a) Quantity
Is ground water table dropping?
Is yield diminishing?
Are "spare" wells or an auxiliary supply available?
Have "long-time" observations been kept as to ground water changes?
Is drilling of wells for industrial or air conditioning uses regulated by city?
Are discharge records of each well kept?
(b) Quality
Is objectionable mineral content, if present, as iron, fluorine, manganese increasing?
Are objectionable gases (H_2S, CO_2) present?
Has a chemical record of wells, etc., been kept for a period of years?

Raw Water Equipment

(a) Is intake structure satisfactory?
(b) Are there "duplicate" or spare raw water screens?
(c) Is there an auxiliary source of power?
(d) Are spare motors, pumps, etc. available?
(e) Are "ice" problems frequent in winter?
(f) Can water be taken from different levels?
(g) Is raw water measured?
(h) Are pumps designed for operating head conditions?
(i) Is the raw water line to plant in duplicate?

Treatment Works

(a) Does plant have ample "reserve capacity" at time of peak demands?
(b) Would failure of any single unit, pipeline, valve, etc., throw the entire plant out of service?
(c) Is the State Health Department satisfied with the (a) physical make-up of plant, (b) operating personnel, (c) records of operation?
(d) Do you consider the plant "flexible" as to operation?
(e) Can the following plant processes be improved or made more economical by new construction, equipment, etc:
Coagulation (including softening) of water
Sedimentation
Filters
Washing of filters—including sewer line
Clear water storage
Sterilization
Measurement of plant process water, etc.
Corrosion control?
(f) Does high service pumping station have:
Satisfactory number of proper sized units
Duplicate source of power
Valve arrangements satisfactory to Fire Underwriters
Satisfactory measuring devices for:
Electricity used
Water delivered to distribution system?
(g) Are "plans" of plant and improvements, etc., thereto kept up-to-date?
(h) Are grounds and plant appurtenances kept orderly and neat?

Distribution System

(a) Have you two or more main feeders from plant to distribution?
(b) Can fire flows be distributed without undue pressure increases?
(c) Do you utilize elevated storage? Is it adequate? Is it properly located?
(d) Have you "standardized" on valves, hydrants, service meters?
(e) Are service meters periodically checked for accuracy?
(f) Are there many "flat" rates?
(g) Is the "unaccounted for" water loss less than 15 per cent?
(h) Are "dead ends" numerous?
(i) Have you made a "cross-connection" survey of your system?
(j) Are ample repair parts, spare pipe, etc. carried in stock?
(k) Have you investigated pipeline corrosion in your system?
(l) Have you "correct" distribution system records showing:
Location and size of mains, valves, hydrants?

Business—Management

(a) Is your record keeping equipment modern?

(b) Is billing equipment modern?

(c) Do you "adjust" unduly large bills?

(d) Are your "contact employees" informed?

A Check List for the Sewage Works Executive

Sewer System—General:

1. Are the sanitary sewers separate from the storm sewers?
2. Is the capacity ample to prevent overflows during storm periods?
3. Are industrial wastes admitted to system without preliminary treatment by industry?
4. Are periodic charges for service rendered made to each contributor of sewage?
5. Is infiltration reducing system capacity?
6. Has there been any "failure" due to chemical reaction in sewers?
7. Do you collect all the outfalls into one intercepter?

Separate Sanitary Sewers:

1. Has roof drainage been excluded from the sewers?
2. Are there "unsewered" areas in your city?
3. Are the manholes adequately spaced for proper cleaning operations?
4. Do manholes need:
   replacement of war substitute covers
   new manhole steps
   reconstruction of failed mortar joints?
5. Are "sewage gas" odors noticeable near manholes?
6. Is there a need for chlorination or other chemical treatment in the system?

Combined Sewerage System:

1. Will cleaning increase carrying capacity?
2. Are additional catch basins needed?
3. Have the sewers been checked for erosion—both physical and chemical?
4. Are "sewer gas" odors obnoxious in dry periods?
5. Are the sewers utilized for:
   (a) snow removal?
   (b) ground garbage disposal?

Sewage Pumping (Lift) Stations:

1. Are stations fully automatic as to operation?
2. Are the pumps properly protected?
3. Are the pumps of proper capacity for efficient, economical operation?
4. Are the operators protected against gas hazard by positive ventilation?
5. Is explosion-proof equipment used?
6. In the event of power failure, is there a by-pass available?
7. Can the station be by-passed for rehabilitation?
8. Are you using sewage gas engines as a power unit?

Sewage Treatment Works:

1. Have you devices for measuring:
   (a) plant influent?
   (b) plant effluent?
2. Have you a by-pass of proper size so that the entire plant may be shut off?
3. Grit Removal and Disposal:
   (a) Are increased channels needed?
   (b) Are repairs necessary to mechanical removal devices?
   (c) Do you wash the grit before disposal?
4. Screenings:
   (a) Are the coarse bar screens in need of repair?
   (b) Are the mechanical cleaning devices satisfactory?
   (c) Are the screenings ground through adequate grinders?
   (d) Is disposal troublesome from a manpower standpoint?
5. Pre-sedimentation Processes:
   (a) Are flocculation devices utilized?
   (b) Is chemical precipitation used?
   (c) Is grease collection and disposal satisfactory?
6. Sedimentation:
   (a) Is the detention period sufficient at all times?
   (b) Will improved baffling give better results?
   (c) If so, do mechanical collecting devices need repair?
   (d) Are there ample interconnections and valves for proper operation?
   (e) Is there need for betterment in scum disposal?
7. Sludge Pumping:
   (a) Are pumps in need of repairs or replacement?
   (b) Are pump pits properly ventilated?
   (c) Are sludge pump discharge lines clean?
   (d) Are there ample interconnections and valves for proper operation?
8. Secondary Treatment:
   (a) Is additional capacity needed?
   (b) Would recirculation improve efficiency in filters?
   (c) Do filters need cleaning?
   (d) Are filter flies a serious problem?
   (e) Are mechanical blowers, distributors, etc., in proper operating condition?
   (f) Do air distributors need cleaning?
   (g) Would sludge concentration be of value in operating the plant?
9. Chlorination:
   (a) Has your equipment an adequate operating range or capacity?
   (b) Have you proper protection devices against accidental breaks in chlorine containers or pipe lines?
   (c) Have you a control system for chlorine dosage?
   (d) Have you any need of additional chlorinators for:
   standby service?
   treatment of ponded trickling filters?
   treatment of clogged porous plates, etc.?
   treatment of returned activated sludge?
   prevention of digester foaming?
   odor control?
10. Solids Disposal:
   (a) Have you sufficient:
   digester capacity?
   vacuum filters?
   elutriation?
   sludge drying beds?
   sludge incinerators?
   glass covered drying beds?
   fertilizer manufacturing equipment?
   (b) Are you recovering and using sludge gas for:
   boilers (digester temperature control)?
   heating of structures?
   power in gas engines?
   grease and skimming incineration?
   (c) Have you any methods of measuring sludge going to and from digesters?
   (d) Are you using lagoons for disposal?
   (e) Are you disposing of dried sludge by:
   grinding?
   sale to public?
   stock piling?
   (f) Can you recirculate the sludge and supernatant in your digesters?
   (g) Have you satisfactorily solved the supernatant problem?
   (h) Is scum handling a problem?
11. General Plant and Operation:
   (a) Are full precautions as to safety of operators taken by protective fences, walks, explosion-proof equipment, etc.?
   (b) Are you utilizing adequate laboratory control over the plant processes?
   (c) Have you a cost account system for the plant?
   (d) Does the plant need a new climb-proof fence?
   (e) Have the grounds been properly graded and planted to grass, flowers, shrubbery, etc.?
   (f) Are flood lights available for night operation?
   (g) Is the plant accessible by a good road?

ESTIMATING FLOWS FROM LOW PRESSURE FIRE HYDRANTS

A Method Also Applicable to Free-Falling Flow from Pipe Lines, Sewers, Etc.

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IN a previous article (*Water Works and Sewerage*, Dec. 1944) a direct reading gage was described for measuring flows exceeding 300 gpm. from a fire hydrant. If a more sensitive gage is employed than the one illustrated it is possible to evaluate lower flows. However, when the stream does not issue with jet force, or when the nozzle flows only partly full, a method based on measuring the trajectory or path of the stream is more convenient and better suited to the situation.

Small flows from fire hydrants are encountered when conducting fire flow tests in towns having deficient distribution systems. This is especially true on the outskirts where pressure may be entirely lost if more than a single fire hydrant is opened. Also, the method is useful when adjusting the flow through new or repaired sections of

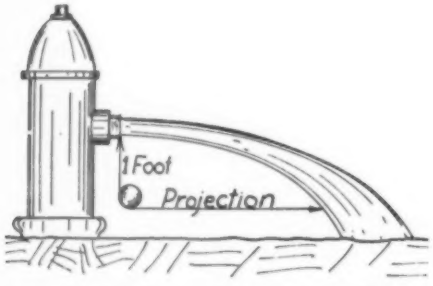

Fig. 1. Trajectory Method for Measuring Flow From a Fire Hydrant

pipe for continuous heavy chlorination. The method is likewise useful in estimating flows from pipes in general where a free fall of the stream from a smooth end section of pipe can be arranged. Although no great accuracy is claimed for the method it is sufficiently accurate for utilization under many conditions.

Description of Method

Known under various names as the X-Y method, the co-ordinate method, and the trajectory method, the procedure consists simply in measuring the distance that the stream has been projected after it has fallen some measured distance. Different modifications measure the deflection according to various detail, thus the reference point in the stream may be along its top, its

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The Author

estimated center, or the underside, whichever system seems best adapted to the purpose at hand. For use in connection with fire hydrant flow, measurement out to the underside of the stream seems desirable for simplicity and convenience.

As shown in Fig. 1 this deflection is for convenience measured at a level 1 foot below the invert of the nozzle. The tape or measuring rod is extended horizontally to a point where its tip just touches the main stream; no attention is paid to irregular side currents that might not be thrown out so far. Drops shorter than one foot result in smaller projections (shorter trajectory) which increase the error in measurement, while longer drops are not applicable for low setting hydrants.

The relation between the deflection and rate of flow is best established by direct calibration. A tank of known volume, say a cask or a milk can, is placed to catch the stream from a high setting hydrant and the time required for filling noted for various openings of the valve. The deflection is also measured several times for each valve setting and averaged. From these data a calibration curve such as Fig. 2, for a 2½ inch nozzle, may be plotted.

[If a special composite rule is used, as described later, this curve will vary slightly according to the manner in which the drop tape is assembled to the case of the horizontal rule.]

Calibration Curve

On logarithmic paper the calibration curve consists of two segments, the lower one corresponding to flow over a broad crested circular weir, and the upper one characteristic of forced flow through a tubular orifice; these cases refer to a partially full nozzle and a completely full nozzle respectively. So long as the nozzle is only partly full an increment in head and cross section of the stream is not accompanied by a proportional increment in projection, since the stream is not forcibly expelled under pressure. Hence for low flows the curve flattens as indicated. Within this region two types of flow can be recognized, namely, a relatively quiet spill over at very low discharge, and a twisting stream having elevated sides when flowing over half full.

At full discharge, starting near 65 gpm., the curve is a straight line having unit slope as expected from theory. When the flow exceeds 250 gpm. the water is blown out at a wide angle, causing deflections of the underside to actually decrease. Therefore, a practical upper limit for use of this method is set by divergence of the stream, although if no other method were available in the higher range, the bottom trajectory curve still might be extended somewhat beyond the recession point.

Theoretical Relations

The equation for that portion of the calibration curve representing the trajectory of a jet under pressure has been derived in textbooks simply by noting that the horizontal component of the velocity is given by the usual nozzle formula and the vertical component is governed by the law for speed of falling bodies. Thus there is always a fixed relation between the vertical drop, the projected travel horizontally, and the rate of flow. In applying this method the drop, for convenience, is set arbitrarily at one foot. The projected throw is measured and the rate of flow thereby established.

Let:

- x = horizontal travel of stream, ft.
- y = vertical drop of stream, ft.
- v = velocity of discharge from nozzle, ft./sec.
- g = acceleration due to gravity, ft./sec.^{2}
- t = time of flow, sec.
- h = head over nozzle, ft. water.
- A = cross-sectional area of nozzle, sq. ft.
- q = quantity, cu. ft./sec.

The horizontal motion of the jet during time (t) is

$$x = vt \quad \text{.....Eq. (1)}$$

while the vertical fall is

$$y = \tfrac{1}{2}gt^2 \quad \text{.....Eq. (2)}$$

eliminating the factor (t)

$$x = v\sqrt{\frac{2y}{g}} \quad \text{.....Eq. (3)}$$

since $q = Av$

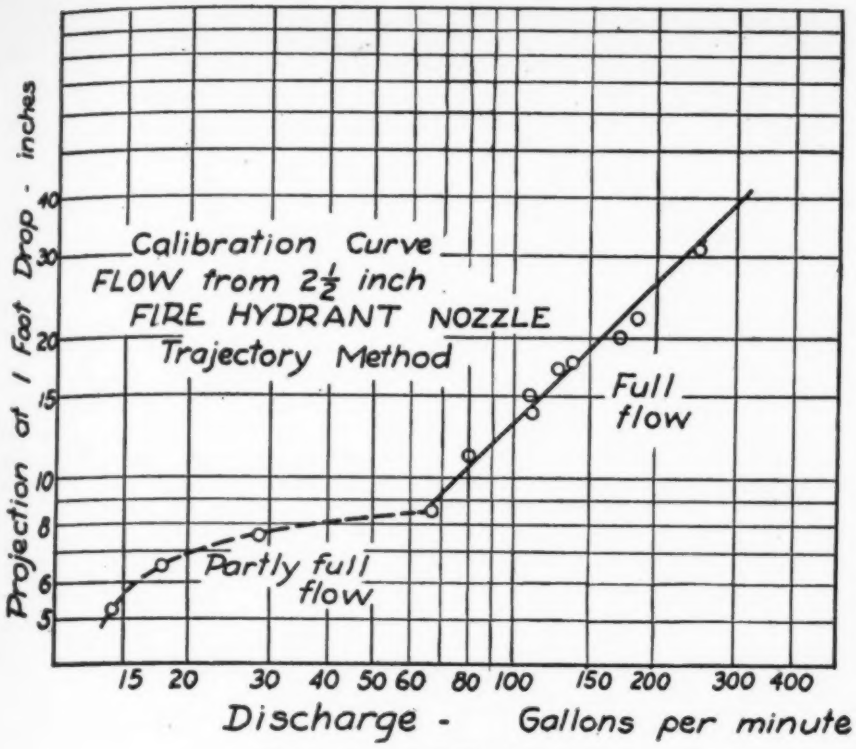

Fig. 2. Typical Calibration Curve

Then,

$$x = \frac{q}{A}\sqrt{\frac{2y}{g}} \quad \text{.....Eq. (4)}$$

which shows that the horizontal projection, at any fixed level, varies directly with the rate of flow. Substituting numerical values in Eq. (4) and expressing flow in gallons per minute the flow in cu. ft./sec. (q) becomes gpm. divided by 7.48 (gal. in 1 cu. ft.) times 60—

And

$$x = \frac{\text{gpm.}}{\frac{.785 \times 2.5 \times 2.5}{144}} \times \frac{7.48 \times 60}{\sqrt{\frac{2 \times 1}{32.16}}}$$

$$= 0.01658 \times \text{gpm.}$$

If the projected distance is measured in inches

$$x_{\text{(inches)}} = 12 \times 0.01658 \text{ gpm.}$$

$$= 0.199 \times \text{gpm.}$$

or 100 gpm. causes a deflection of 19.9 inches.

This derivation is based on average displacement, as from the center of the nozzle tip to the center of the stream, and checks closely other data obtained under such conditions. When the distance to the underside of the jet is measured, however, it is found, as shown on the calibration curve, that 100 gpm. flows at a deflection of only 13.0 inches. This smaller projection is due to widening of the stream both hydraulically and geometrically as cut by a horizontal transcept.

Special Rule

Rather than measure deflection of a stream and refer to the calibration chart, the rule (such as an encased steel tape) may be divided (by means of painted marks) as indicated in Fig. 3, to express flow directly. A completely self-contained device to set the level at one foot drop and to measure out to the stream, as in Fig. 1, may be made by attaching a short auxiliary steel tape to the case of the main rule in such a way that when applied to the hydrant the required level is established. This drop tape may be attached in a number of ways depending on the type of case. The simplest possibility is with cases having a hollow central rivet through which the drop tape may be bolted. The assembly can then be compactly wound and carried in a small pouch of soft leather or cloth.

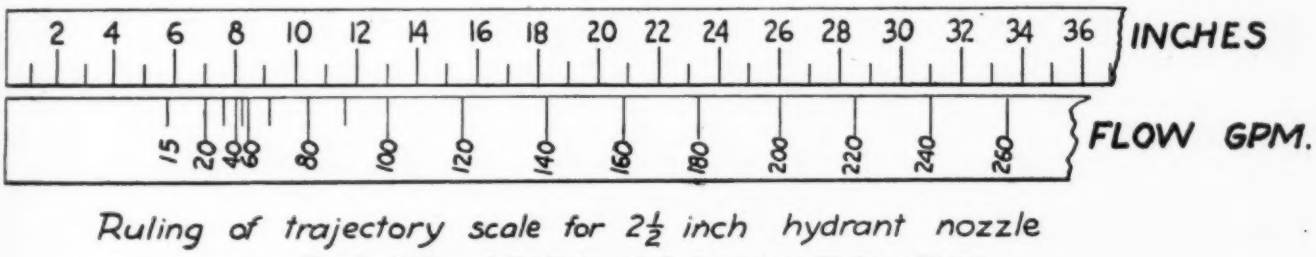

Fig. 3. Ruling of Trajectory Scale for 2½-In. Hydrant Nozzle

"Pre-historic"

This strange looking specimen has the appearance of being the remains of the great granddaddy of the Cyclops. It is to be found on the watershed of Greenville, S. C.

Now, if the lover of things less strange and more beautiful will make a closer inspection of this natural curiosity by turning the page 90 degrees to the right he will have a mirrored view of Table Rock Mountain across Greenville's reservoir of the same name.

Interestingly, the reflected view of the mountain is sharper than the true view. But turn it 90 degrees to the left also and take your choice.

A RAPID DEMONSTRATION OF METAPHOSPHATE PROTECTION

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State Department of Education
BATON ROUGE, LA.

THE utility of sodium hexametaphosphate for corrosion control in water supplies is apparent from its successful use as reported for nearly 300 public supplies[1]. A rapid method of demonstration, one that is definitely conclusive in about an hour or so, is desirable, when discussing protection against corrosion by means of this chemical. Observations of the corrosion of water on steel wool plugs in a flow through apparatus[2] and bubbling of air against a steel surface submerged give demonstrable differences when conducted in untreated and corrected water samples but the amount of apparatus required in these experiments are drawbacks for general use.

Corrosive properties of water supplies are due primarily to the presence of dissolved oxygen. Rather than depend on the oxidizing action of dissolved oxygen, whose concentration is limited by solubility under conditions of the test, the corrosive attack may be greatly accelerated, for purpose of demonstration, by addition of calcium hypochlorite. Since sodium hexametaphosphate protects the metal by some type of surface layer, shielding is also somewhat effective against the oxidizing power of mild chlorine solutions.

To perform this experiment 0.5 gram portions of steel wool are immersed in gallon samples of (a) tap water, (b) tap water containing 20 ppm. of sodium hexametaphosphate (Calgon), (c) tap water containing 100 ppm. of chlorine, and (d) tap water dosed with 100 ppm. chlorine and 50 ppm. sodium hexametaphosphate (Calgon).

In the portions containing hexametaphosphate, this chemical and the steel wool should be added at least an hour in advance of the hypochlorite, a detail established by separate experiment, so that the protective film will have time to form. Even short soaking periods will show improved corrosion resistance by the metal surface.

Observations

In general during a brief exposure little or no rust forms in the first two cases above, unless the water is extremely corrosive in which instance the first bottle only will show incipient rusting. Hence the inhibitory power of sodium hexametaphosphate usually cannot be properly gaged from short term exposure results on tap water control and metaphosphate treated tap water. On the other hand decided rusting shows in the chlorinated tap water while the chlorinated sample containing hexametaphosphate remains free or nearly so from rust, thereby demonstrating the efficacy of anti-corrosion treatment. If the jars are allowed to stand overnight a yet greater difference will be noted between the amounts of corrosion in unprotected and protected solutions. Results of several corrosion demonstrations with different public supplies are shown in the accompanying table.

In some of the tests, particularly those at Marrero, an attempt was made to determine the Calgon needed to protect steel against various chlorine concentrations for varying exposure periods, but results were irregular and not amenable to plotting. Two types of corrosion were distinguished, small orange spots which appeared early or late, restricted in area where protected but widespread on straight chlorinated specimens; and the formation of a colloidal ferric oxide suspension which, because of its density, streamed slowly down from the steel wool to the bottom of the vessel, gradually depositing rust sludge and accounting for the bulk of the corrosion. The steel wool in many cases hardly showed rust scale although considerable ferric oxide sol had accumulated.

Qualitative Conclusions

Qualitative conclusions based on results so far obtained are:

1. Heavily chlorinated water samples furnished an effective medium in which to demonstrate quickly the protection against corrosion afforded by sodium hexametaphosphate. Larger doses of the hexametaphosphate are required than for anti-corrosion treatment of public water supplies.
2. Amount of rust formed in chlorinated water seems the better evidence of protection than does the time required for its initial appearance, since inverted orders in time are frequently noted but not so with the volume of rust sludge.
3. In tap water, without added chlorine, the time required for the initial appearance of the streaming ferric oxide sol furnished a good quantity for comparative measurements of corrosion protection.
4. At high chlorine concentrations, all specimens of steel wool rust despite high metaphosphate dosage, but the rate of corrosion is retarded considerably by increasing the metaphosphate treatment.

*Director, Sectional School on Water Supply and Sewerage.

TABLE I
Corrosion Observations on Steel Wool in Chlorinated Tap Waters Containing Sodium Hexametaphosphate.

Tap Water Used	Chlorine ppm.	Observations	Chlorine as previous with Calgon ppm.	Observations
1. Monroe	100	Dark orange rust on shreds within the hour Much rust sludge formed overnight	50	Light orange rust forming slowly and restricted in area Overnight corrosion about 2% that of unprotected steel wool
2. Alexandria	110	Rusting within 10 minutes	50	Rust appears after 40 minutes
3. Natchitoches	200	Rusts within 5 minutes	50	Rusts in 30 minutes
4. Marrero	0	Heavy ferric oxide sol in 75 minutes	10	Slight ferric oxide sol forms in 2 hours
	0	do	20	No rust during 2½ hours observation
	100	Considerable ferric oxide sol streams from wool in 3 minutes	20	A few isolated rust spots in 13 minutes; ferric oxide sol noted within 2½ hours

References

(1) Committee Report "The Value of Sodium Hexametaphosphate in the Control of Difficulties Due to Corrosion in Water Systems," Jour. Am. Water Wks. Assn., 34, 1807 (1942).
(2) G. B. Hatch and Owen Rice, "Corrosion Control with Threshold Treatment," Ind. and Eng. Chem., 32, 1572 (1940).

SOUTH JERSEY "SUPERS"

Resume Meetings with Famed Shad Roast

A CHILL spring wind blew in across Delaware Bay and through the grove of the Salem, N. J. Country Club, but this did not affect the attendance of the 140 who came to one of these famed South Jersey Shad Roasts at old Salem, N. J. on April 27th.

This marked the resumption of the bi-monthly meetings of the 18-year-old South Jersey Ass'n of Water Superintendents, whose meetings had been "suspended for the duration." Perhaps the decision to resume these meetings presaged the folding-up of Germany and the unhappy end of Messrs. Mussolini and Hitler. In any event the Annual Old Fashioned Delaware River Planked Shad Dinner was held and the boys (and the gals too) were all happy to see each other again after the long suspension of these neighborly meetings in the South Jersey territory.

Officers and Executive Committeemen

J. H. Simmerman, Treas. Pitman, N. J. — *Walter Spencer, Secy. Merchantville, N. J.* — *C. D. Moon, Vice-Pres. Haddon Heights, N. J.*

E. D. Sheehan Camden, N. J. — *(Missing was Pres. "Bill" Collings of Collingswood)* — *J. D. Campbell Merchantville, N. J.*

For the benefit of those who have never attended one of these Old Fashioned Shad Roasts, here is how its done. When the members and guests began to arrive at 4 P. M. the shad roasting was already well under way. In front of Ye Man's-Sized Fireplace of the Club was seen a semi-circle of butter-saturated charred white oak boards (8x2 inches) about 30 inches long, standing almost perpendicularly with the bottom end resting in a drip pan, and supported easel-wise by props from behind. On the face of these well used oaken planks were strapped with metal strips tacked down, halves of large roe-shad freshly taken from the Delaware Bay. The firetender was keeping his oak and hickory wood fire just right, and occasionally swabbing his browning denizens with the secret formula sauce and drippings from the catch pan. The boards (planks) were well charred, of course, and hot fat sizzled from their ends and sides. Sure, there was some fish smoke in the room that didn't get pulled up the big chimney, but that just made for better appetities. However, the real mouth-watering came about from watching planked fish halves (inside to the fire) turn that rich gold and then that well-done brown. Well, on the plates, red hot, these planked shad are "something to write home about," as the boys would say. Nobody worries much about the many bones in shad when the taste is that of these smoke planked shad. Are you envious—if not, you've never been introduced to the delectable bay-shad of our Eastern estuaries and inlets when the Spring Shad Run is on.

High Class Entertainment, Too

So much for the repast—we've really forgotten what the balance of the meal was other than the golden brown long-branch potatoes surrounding the shad. And there were seconds, and even thirds, of shad serving if one could handle that much.

Following the dinner there was a floor show comparable to any. A novelty was the nifty female sleight-of-hand artist, with witty conversation to keep the act lively and intriguing. Then there was Charlie McCarthy's uncle who, as a voice thrower, wasn't bad. And at the last, the "piece de resistance," came a charming and vivacious young blonde with a stage presence superb and a voice which brought her back for encore numbers until the audience felt a conscience—but this remarkable young lady aimed to please; and she certainly did. She was really "top-billing" stuff. Congratulations to Harry Taylor who brought these artists, and who gave full money's worth with his piano work that evening.

The Technical Session

The Business and Technical Session was held in the late afternoon prior to

Some of the Ladies Attending

Mrs. John Simmerman Pitman

Mrs. Alan Wood N. Philadelphia

Mrs. Winfield Codell Philadelphia

Mrs. Calvin Ellis Moorestown

Miss Mary Louise Harris Haddon Township

Mrs. A. J. Harris Haddon Township

Mrs. Walter Spencer Merchantville

Mrs. Edw. W. Campbell Merchantville

Mrs. Adelaide Spear Collingswood

(Member of President Collings' staff, served at the registration desk)

Mrs. J. W. Chew Merchantville

Mrs. M. E. Plaskett Woodstown

Mrs. F. R. Freestone Ocean City

Mrs. Elmer Steelman Ocean City

Mrs. C. D. Moon Haddon Heights

"Madame" Jack Faulks Maplewood

Mrs. S. Billbrough Paulsboro

"Mlle." John Radcliffe Elizabeth

dinner. Being the annual meeting, election of officers was the first in order, the following being elected:

President: (3rd Term), Wm. E. Collings, Supt., Collingswood, N. J.

Vice-Pres. (3rd Term), Clinton Moon, Manager, N. J. Water Co., Haddon Heights, N. J.

Treasurer: (10th Term), John H. Zimmerman, Sup't. Pitman, N. J.

Secretary: (17th Term), Walter Spencer, Ass't. Sup't., Merchantville, N. J.

Exec. Comm.: Jos. D. Campbell, Sup't., Merchantville, N. J.; Edw. Sheehan, Sup't., Camden, N. J.; M. Brunstein, Chemist, Atlantic City, N. J.; Alfred Harris, Sup't., Westmont, N. J.; Alonzo Shinn, Sup't., Burlington, N. J.

Retirement Plans

In the absence of President "Bill" Collings, Vice-President, "Clint" Moon presided. In fact Mr. Moon was likewise the leader of a programmed discussion of "Social Security Benefits and Pension Systems of Private Water Utilities" in contrast with the municipal water works employee as the "forgotten-man" in this age of old-age security planning for the hired man of the nation.

Mr. Moon described the Pension Plan and System of Retirement of his company, The New Jersey Water Co., Haddon Heights, N. J., which is a subsidiary of The Sun Water Works & Elec. Co. The plan outlined applies to all operating units of the latter company. As we understood it, the details were not intended for general publication, but the pension available to employees—subject to retirement at whatever age proves justified—is liberal; and when added to Federal Social Security benefits it seemed liberally ample to those gathered, most of whom were employees of municipal systems. The company matches the pension deductions from the pay of employees. It is the hope of this reporter that we can get the full story on AWW&E's retirement and disability plan for publication in *Water Works & Sewerage* at a future time.

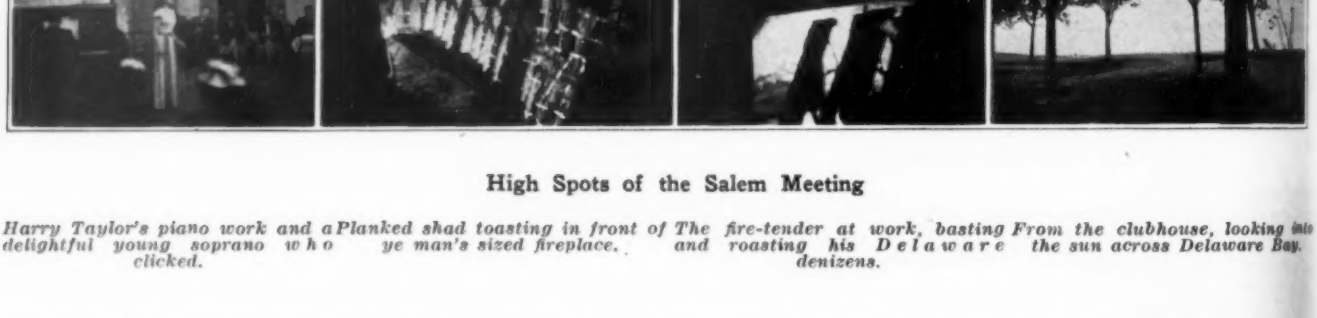
Presider
C. D. Moon
Manager
N. J. Water Co.
Haddon Heights
(1st Vice-Pres.)

Mainspring
"Walt" Spencer
Asst. Supt.
Water Comm.
Merchantville
(17 Yr. Secy.)

Following Mr. Moon, came J. A. Wood, Sec'y, of the State Employee's Retirement System, Trenton, N. J. and Ass't.-Sec'y, Geo. M. Borden to describe the workings to the State's System. The explicit reason for Mr. Wood's presentation was to familiarize municipal water works men with the system which was instituted as a pensioning system for State employees but has never become available to municipalities as well.

Apparently the "System" is set up as a corporate body free of political domination. It is financed by the State, but is now on a financial basis which is sufficiently strong so as not to require further underwriting by the State.

The benefits of the "Retirement Plan" can be had by any New Jersey municipality, county or township which votes to go into pensioning of employees and is willing to match the employee contributions with an equal payment into the fund. The whole system is of course based on group insurance and group annuities. The system is managed under strict insurance and savings bank laws of New Jersey. The system has been operating long enough now to have passed over the "hump" and according to Secretary Moon there is no gamble involved when it comes to hazards of a run on the fund—incidentally invested in governmental and municipal securities yielding now 4% because of bond purchases on a low municipal market. With this "System" now available to *all* municipalities regardless of size, there seems no excuse for N. J. Water Works and Sewerage employees to longer go without some form of old-age security pending extension of the Federal Social Security to municipal employees.



High Spots of the Salem Meeting

Harry Taylor's piano work and a delightful young soprano who clicked. *Planked shad toasting in front of the fire-tender at work, basting and roasting his Delaware denizens.* *The fire-tender at work, basting From the clubhouse, looking into ye man's sized fireplace.* *the sun across Delaware Bay.*

Mayors and Commission Heads Attend

One impressive observation in connection with the South Jersey Supt's Ass'n. meeting was the number of Mayors and Presidents of Water Commissions in attendance.

Crane Makes Mork Exec. V. P. and Dwyer V. P. in Charge of Sales

Crane Co. announces the recent election of P. R. Mork as Exec. Vice-Pres., and J. A. Dwyer as Vice-Pres. in Charge of Sales to succeed Mr. Mork.

Mr. Mork started with Crane in 1901 in the Minneapolis branch warehouse. He has served as manager of Crane's Duluth, Minneapolis and the New York branch offices and warehouses. In 1934 he was called into Chicago and made Vice-Pres. in charge of sales.

Mr. Dwyer started with Crane in 1917 in the Philadelphia branch, served in World War I, returned to climb Crane's ladder to become Manager of Branch Houses in 1943 and General Manager of Sales in 1944.

WHY USE "BREAK-POINT"?

By E. E. CHANDLER*
Consolidation Coal Co.
FAIRMONT, W. VA.

WHY Use Break-point Chlorination? The answer will be obvious from the few remarks that follow. A short time back, I too, would question the wisdom of changing from a fairly satisfactory method of treating water for odor and taste, to a new treatment about which I knew nothing.

Early in 1941 I was employed by the Beckley Water Co. as chemist. At that time the city water supply was mine water, but the rapid growth of the town had outgrown the water supply, so a new surface supply was acquired and a new plant built. The old supply was treated with lime and chlorine, but the new supply required complete treatment of coagulation, sedimentation, filtration, and chlorination.

The new supply was carved out of the wilderness, creating a lake covering 130 acres. All the brush was cleared and burned off the lake site, but it was decided not to strip the top soil because the cost of this operation would exceed the cost of removing the organic matter absorbed by the water from it. This proved to be a very wise decision, because the cost of treatment compares favorably with that of other plants.

*Formerly chemist, Beckley Water Company, Beckley, W. Va.

Chlorination

Chlorine is fed to the water through two Wallace & Tiernan chlorinators. The break-point is ordinarily reached by the addition of 100 lbs. chlorine per day, the top limit of the then installed chlorinating equipment. This dosage proved to be too small for peak demands. Since WPB regulations at that time precluded the purchase of a larger chlorinator, the needs were temporarily satisfied by the manufacturer who rebuilt the existing equipment to higher capacity. Post chlorination was obtained by a 12 lb. machine which could also be used for dechlorination with sulphur dioxide, if need be. Ammonia was introduced through a W&T ammoniator. Post ammoniation was accomplished by adding anhydrous ammonia through an ammoniator to the finished water.

Start of Break-point Chlorination

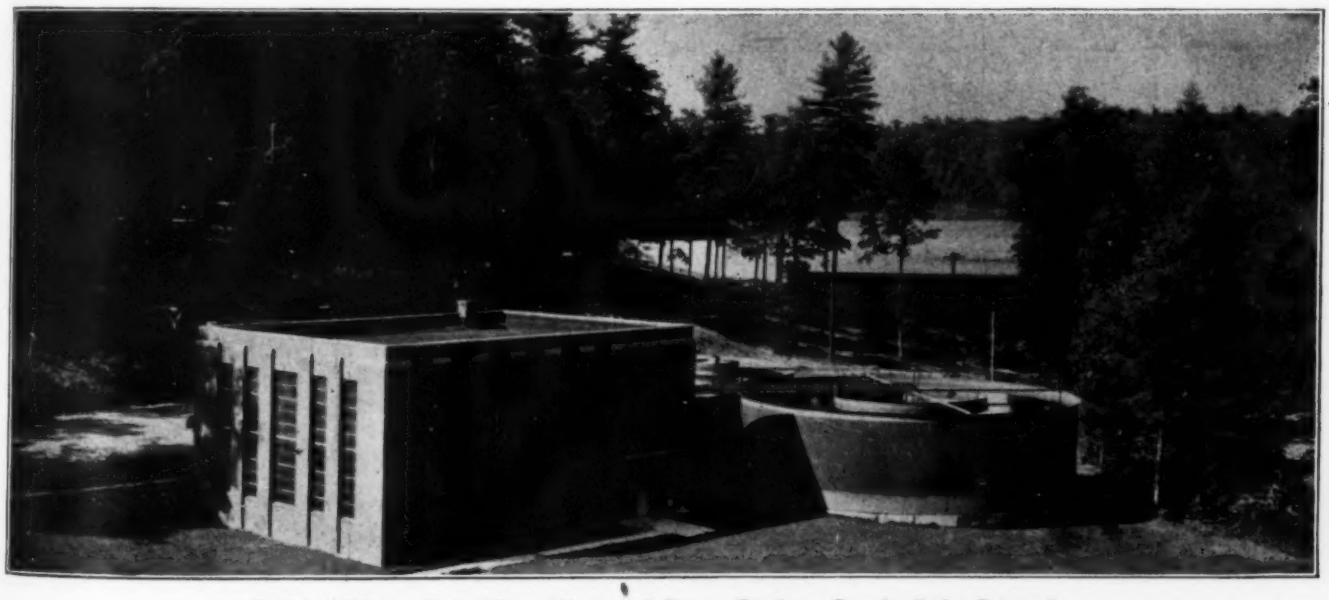
Break-point chlorination was started in the winter season when the water contained very little organic matter. The analysis of the water at this time is shown in Table 1.

TABLE 1

Item	Ppm.
Color	0.0
Hardness	6.0
M.O. Alk.	5.0
Phth. Alk.	0.0
CO_2	1.0
Fe.	0.0
Mg.	0.0
pH.	6.6

This analysis indicated a very pure water. The dosage of chlorine to the break-point was 1.5 to 2.0 ppm., which produced a residual of 0.8 ppm. at the settling basin influent, and 0.2 ppm. *flash* residual in the filter effluent. Later, after the organic matter had been removed from the filters by the action of chlorine, the flash residual in the filter effluent rose to 0.6 ppm.

This condition held true so long as the sun did not shine on the settling basins, or during the night and on cloudy days, or when the basins were covered with ice. The sun removed the free chlorine during the day, so from 2 to 4 pounds of chlorine were added to the plant effluent to hold the free chlorine to the desired concentration in the finished water. It is interesting to note that every bit of the chlorine added in this post chlorination showed up as chlorine residual in the finished water.



Beckley Water Co.'s Filter Plant and Pump Station—Supply Lake Beyond

(Features of this compact and trim 2 mgd. plant include a combination of all-steel tanks, providing aeration, mechanical mix and flocculation, clarification in twin spiral baffled tanks, four all-steel circular filters equipped with Palmer Filter Bed Agitators. For a full description of the Beckley plant see the lead article in Water Works and Sewerage, for May, 1943.)

The free chlorine, however, reacted with the coal tar enamel lining of the water main leading to town and created a medicinal taste. It was decided to add ammonia to the finished water to change the free chlorine to chloramines. The dosage of ammonia is controlled by the ortho-tolidine test. Enough ammonia is added to fully form chloramines. This usually requires from 1 to 2 lbs. per million gallons.

It was a surprise to find a chloramine residual in the distilled water. In preparing color standards of platinum-cobalt solution, it was impossible to prevent the platinum from precipitating. After several trials, the distilled water was tested for chloramines and showed a residual of 0.3 ppm. Some of the water was redistilled, but the chloramines persisted. After connecting the still to the unchlorinated raw water supply, there was no more trouble.

Warm Weather Conditions

As warm weather arrived, algae, Crenothrix (iron bacteria), and organic matter began to appear in the raw water. The chlorine demand rose accordingly, but the quality of the finished water remained the same. An increase in the alum demand had been anticipated because in the fall of 1941 the alum dosage rose to 1000 lb. per million gallons. However, the dosage remained the same from 1.0 to 1.5 gpg., or about 190 lbs. per million gallons.

As the chlorine demand gradually rose, the optimum pH decreased from 6.4 to 5.2. The break-point demand gradually increased until early fall, when a peak demand of 105 lb. per million gallons was reached. The odor in the raw water at this peak was first fishy, later, hydrogen sulphide. This odor became very intense and could be detected in the air 150 yards from the aerator. The analysis of this water follows.

TABLE 2

Item	Ppm
Color	250.0
Hardness	37.0
M. O. Alk.	22.0
Phth. Alk.	0.0
CO_2	18.0
Fe.	2.0
Mg.	1.8
pH.	5.6

In comparing this analysis with that of the supply in the winter, the two extremes at which break-point was working are apparent. The finished water, however, remained about the same—the average analysis being given in Table 3.

TABLE 3

Item	Ppm.
Color	Clear and sparkling
Hardness	27.0
M. O. Alk.	16.0
Phth. Alk.	2.0
CO_2	0.0
Fe.	0.0
Mg.	0.0
pH	8.4

After the use of break-point chlorination was started, there were never any positive tubes on any of the finished water samples, and very seldom a plate count.

With the use of break-point chlorination, several problems were solved, treatment was simplified, and cost of treatment was reduced, due to smaller dosages of alum and lime, and the elimination of carbon and copper sulphate. The break-point demand required about 20 per cent more chlorine than the marginal demand.

Problems Solved

Some problems encountered at the plant were almost impossible to solve. When lime was used to remove the 2 ppm. of iron in the raw water, it was impossible to remove the color. If coagulation at a low pH was used to remove the color, how was the organic manganese to be removed at the high pH required for removal? If alum alone was used to remove the color, the 2 ppm. iron remained in the water to make the finished water appear rusty when lime was added for corrosion control. This was the combination to be dealt with.

With the application of chlorine to the break-point, the results were very satisfactory. The iron and manganese were oxidized at the low pH, and the 250 ppm. color disappeared. Algae and iron bacteria were completely destroyed. The finished water appeared clear and sparkling with no odor or taste, and completely free from bacteria.

The above account shows break-point chlorination working in two extreme conditions; that is, giving the same results in a water with low organic and mineral content. And in a water with a high organic and mineral content; that is, a water that changed from almost pure water to one that is polluted.

Questions and Answers

One question often asked is: How do you know you have "break-point?" The answer is simple. After the chlorine has had contact with the water for from 2 to 3 hours, a sample is tested with O-tolidine. If the full color is developed instantly (this does not mean one minute after O-tolidine is added, but from 5 to 10 seconds after O-T is added) free chlorine is present in the water and chlorination is above the break-point.

Another question is: Who can use break-point? The answer is any person applying chlorine to water can apply chlorine to the break-point. The only equipment needed for tests are 6 or 8 beakers, jars, or bottles, ortho-tolidine solution, and a chlorinator with a capacity large enough to apply all the chlorine needed.

Very often the difference between the addition of chlorine to the usual residual, and the addition of chlorine to the break-point, is just a few pounds per million gallons. With some water supplies, when enough chlorine has been added to produce an ordinary residual, a strong medicinal taste results. This shows that chlorination is short of break-point curve, and perhaps with the addition of a few more pounds per million gallons, true active residual chlorine could be obtained which would result in a water completely free of bacteria, and taste and odor as well. Several water supplies having a medicinal taste have responded to treatment with a very small amount of additional chlorine, resulting in complete dissipation of the taste.

The writer believes there are but two places that break-point treatment can fail in a water plant—the chlorinator and the operator. If the chlorinator is kept in good repair and its capacity not stretched, it will not fail. If the operator checks the water every 30 minutes, or at least once an hour, to see that the full color is instantly produced, he will not fail. Once the saying was "Don't use enough chlorine to cause a taste if you can help it." Now, one says, "Use enough chlorine to destroy the taste." If this practice is followed, you will never have any taste complaints, and will never, never have any water-borne epidemics in your town.

Why Use Break-point? On the basis of Beckley's experience, the reasons may be summed up as follows: Briefly, it eliminates odor and taste; it oxidizes iron and manganese; it removes color; it sterilizes the water, and keeps the filters and mains free from organic growth.

SELECTING DEEP WELL CENTRIFUGAL PUMPS

Considerations When Taking Into Account Anticipated Ground Water Level Recession

PART III

By AXEL O. FABRIN
Pump Designer
MEMPHIS, TENN.

INDISPENSABLE and expendable resources approach near exhaustion when the principles of conservation are ignored, misunderstood or misinterpreted. Water is one of these resources which is supplied by nature in quantities governed by irrevocable laws that are and have been essentially uniform through the ages.

The popularity and increased employment of wells and pumps in public utility and industrial fields has put unprecedented demands upon ground water supplies. From records it appears that because of vigorous pumping, demands are greater than the natural supply, and statistics on the trend of ground water levels in many sections of the United States point to a decided need for legislation to control well construction and regulate operation.

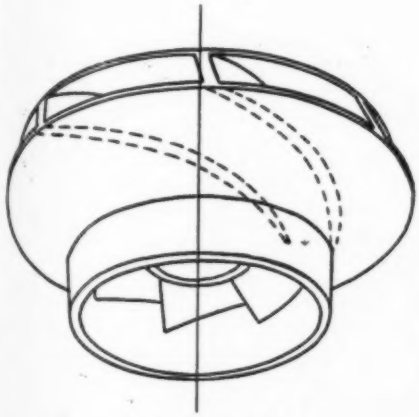
Men in close touch with the situation realize that in the arid and semi-arid regions of this country human life and industry to a great extent depend upon well water for their existence, and that if by reason of deep water levels the pumping costs become prohibitive, future development is questionable and may become impossible. Population and industry, being mutually associated, then become static. To the states belongs the duty of prescribing specific laws on ground water conservation in their particular confines, with due respect for bordering states which might be injured by too ambitious limitations. Perhaps general laws relative to interference of one state with another as regards water depletion belong to the Federal Government, but certainly not the detail organization within the states. There is a special reason for making this statement, and the basis for it is found in the first annual report of the U. S. Geological Survey published in 1900. Reference to this will be made later. The gradual lowering of the ground water table cannot be traced to any one cause but is rather the result of economic expansion in its many phases. This expansion affects the natural underground reservoirs from which wells get their supply and also affects the surface streams. It changes the characteristics of rivers, often engendering flash floods in seasons which in the past were without floods.

The Author

Lakes have been known to become dry because their sources of supply, which were springs or flowing wells, no longer conveyed the water from the former water level near the ground surface. Some of the north mid-western states which have become deservedly famous for their beautiful summer retreats have actually had to resort to deep well pumping as the source of supply of water to maintain and perpetuate lake levels.

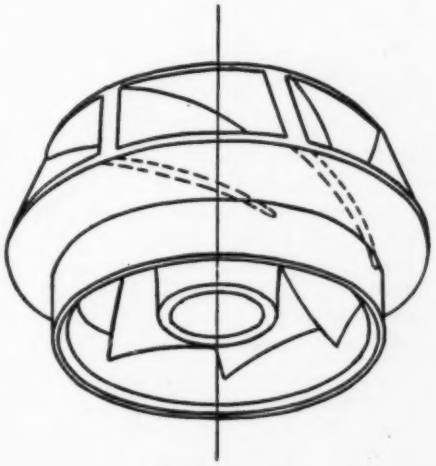
Causes of Ground Water Recessions

Opinions on the causes of ground water recession differ. There is no denial that the causes are several,



Sketch No. 1
Design Characteristic of Impeller of Low Specific Speed (Ns)

Part I of Mr. Fabrin's exhaustive article on the "Selection of Deep Well Centrifugal Pumps" is to be found in our issue of October, 1944, and Part II in the November, 1944, issue. Part III constitutes the concluding installment of this worthy treatise and guide in the important matter of developing specifications for, and in the ultimate selection of, deep well pumps.



Sketch No. 2
Design Characteristic of Impeller of High Specific Speed (Ns)

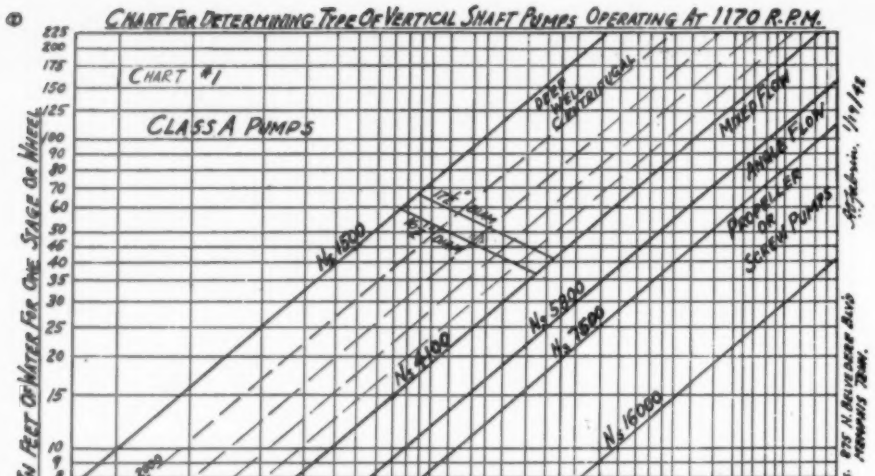


Chart 1.—For Determining Characteristics of Deep Well Pumps Operating at 1170 RPM.

but the degree in which each cause affects the whole has been the subject of debate.

The source of all fresh water supply existing either in the ground or on the surface is precipitation in the form of rain or melting snows. In the case of ground water the supply enters at locations where the layers or strata of the earth bend or tilt upwards so that the ends of the formation act as collectors. The outcropping layers are invariably covered with vegetation and this area is commonly called a watershed.

Excess water that does not enter the earth at the outcrop drains down the surface slopes and is called runoff water. The water that thus flows to the creeks and rivers is diminished by evaporation and percolation into the top soil over which it passes.

Most large rivers originate in forest areas or areas of rock outcrop. As they journey to the sea, drainage from hills and mountains arrives at the river after flowing over the plains, which for centuries have been areas of aggregation built up by residual soil, deposited by the runoff water from the hills.

The rich soil lying near the river is punctuated by shallow depressions filled with land-locked water forming swamps. While swamps are the natural habitat of insects, which in many cases cause fever and other human misery, they also serve as recharging means whereby moisture can slowly percolate into the soil. The richness of the soil near rivers lures agriculture. Because of this, swamps and lowlands are drained, quickening the run-off and delivering to the rivers great quantities of water, sometimes in volume that the rivers cannot handle immediately, and thus we have overflows or floods.

It seems reasonable to believe that the drainage systems have affected somewhat the underground storage, but this factor alone cannot be said to have a major influence. The immediate benefits derived from the rich drained soil far outweigh physical discomforts which would accrue if the land were allowed to revert to swamps.

Forest fires and indiscriminate timber cutting have done much to destroy the blanket or mat of leaves or other vegetation which earlier acted as a sponge that retained the moisture and allowed slow percolation into the soil.

The Need for Governmental Regulation

The subject of ground water origin and the variation in underground levels is indeed a highly specialized subject and these few remarks are intended to illustrate that the fundamental changes in pumping levels from year to year are not under the immediate control of well water users. Because of increased pumping cost due to receding levels, the future will perhaps invite favorable regulations relative to the number and capacity of wells permissible in a given area. It is, of course, understood that such regulations should not be arbitrary, but in each district or area must be peculiarly adapted to the geological conditions governing the water supply in that area.

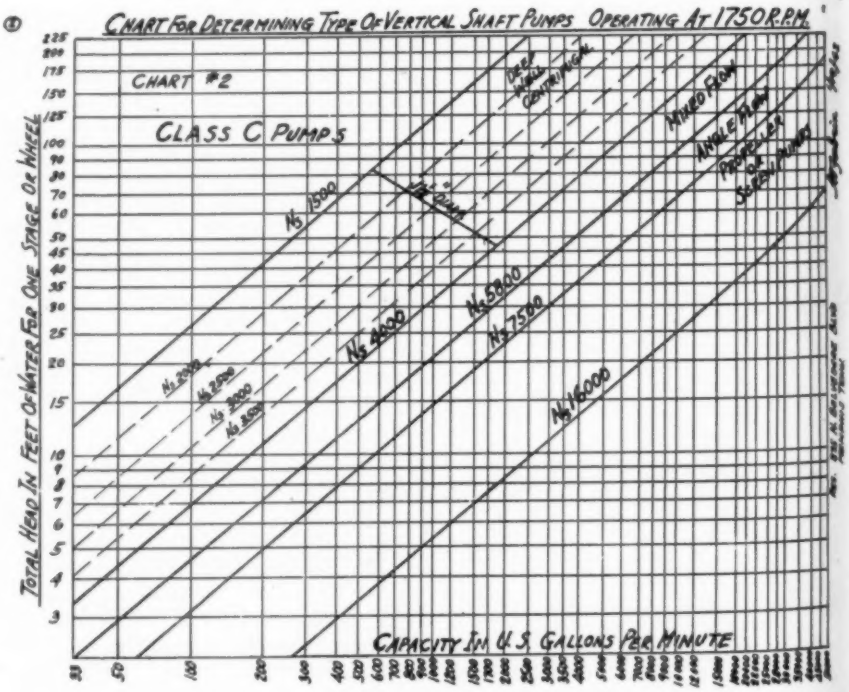


Chart 2.—For Determining Characteristics of Deep Well Pumps Operating at 1750 RPM.

It is reasonable to believe that control will be indexed to geological conditions, but it is interesting to note that government regulations do not always follow natural laws. It is easier to issue blanket rules and follow precedent. The first annual report of the U. S. Geological Survey published in 1900 suggests the fallacy of such procedure when it reveals that the government surveyors, when determining the boundaries of western land division, merely were concerned with square or rectangular plats, all of essentially equal size, extending to regions that had no access to the run-off surface water near the mountains. Up until the time when the development of ground water supply and deep well pumping was well under way, settlers often found that they were located in essentially desert land and, in order to secure water, were put to great expense and endless litigation over water rights. The method and plan of western land subdivision were under the supervision of surveyors whose past experience had been confined to similar work in the humid and semi-humid areas of the east and midwest where surface water was extant and plentiful, since precipitation was generally uniform.

It will always be a matter of conjecture as to what would have been the degree of western land development if deep well pumping had never been instituted, but it is modest to venture the statement that wells and pumps prevented the unintentionally erroneous principles of land subdivision from becoming a matter of serious consequence. Irrespective of geographic locations, large cities and industries are naturally regions of dense population, and when their water supply comes from wells, the concentrated demand upon the ground water supply in a relatively small area becomes greater than the natural replenishment.

Therefore, in these areas the pumping elevation drops to low levels. Thereupon, even as much as twenty or thirty miles away the levels will be affected, but not as greatly as in a confined pumping area. Several cities in the United States have recognized this fact and have located their wells miles away from the city proper.

Very large cities generally depend upon surface supplies because the ground water to supply a well system cannot flow in through the strata fast enough to supply the great withdrawal demand.

Most of the data on receding ground water levels are taken from dense population centers. These observations indicate an average drop of from three to four feet a year. In general, such sections take their water supply from a strata or stratas fed by one of the continental water sheds. There are, however, countless minor water sheds which support

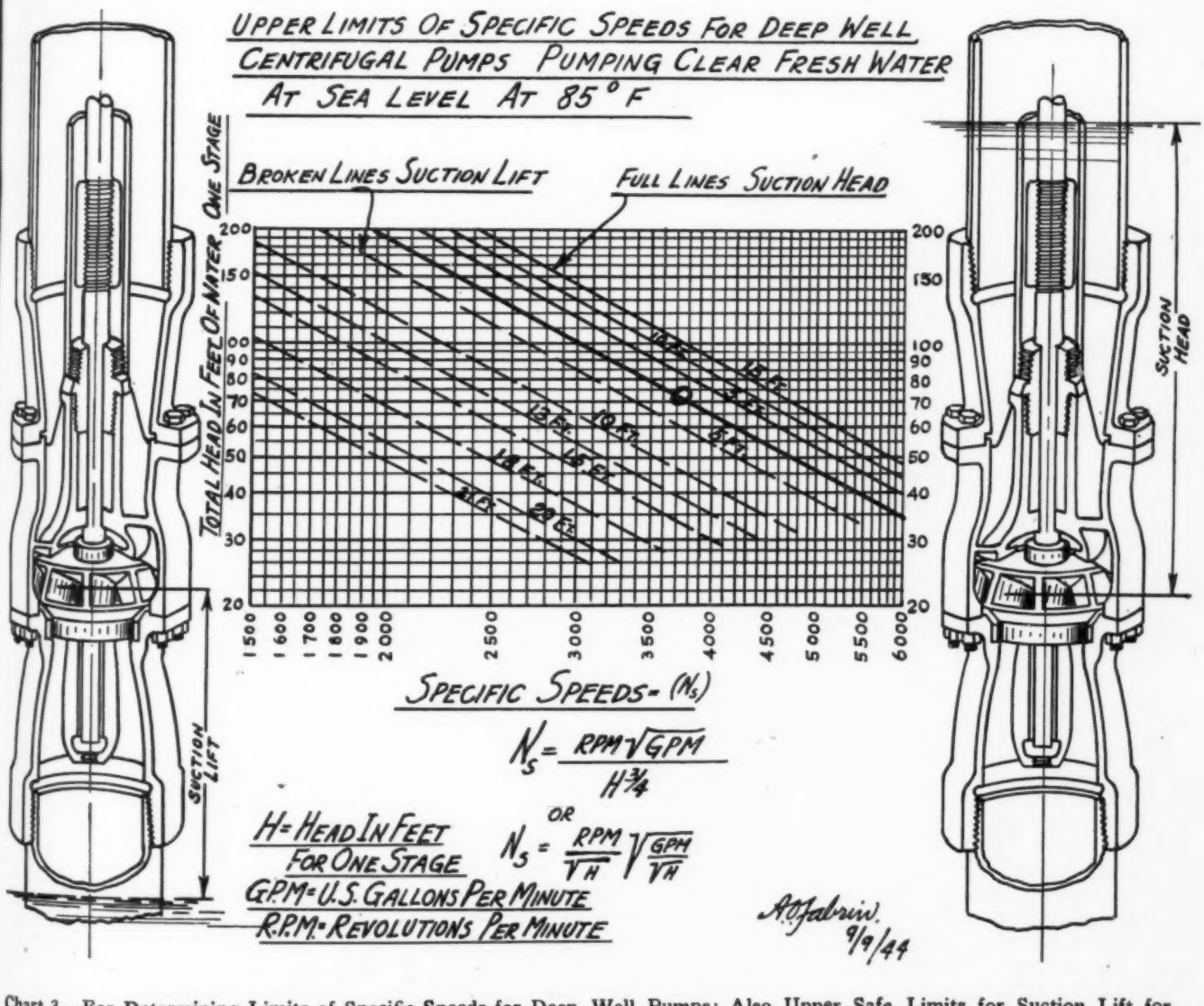
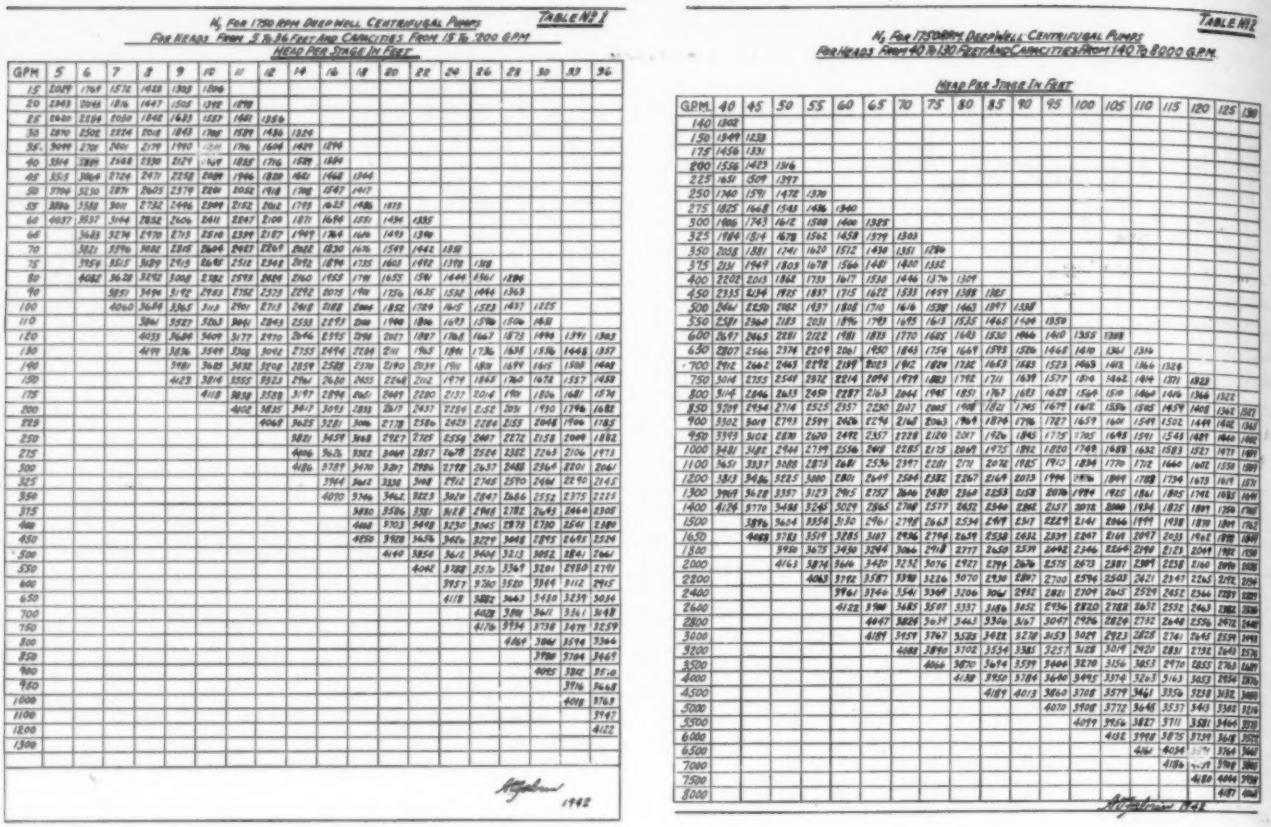


Chart 3.—For Determining Limits of Specific Speeds for Deep Well Pumps; Also Upper Safe Limits for Suction Lift for Efficient Cavitation Free Operation



Ns FOR 1750 RPM DEEP WELL CENTRIFUGAL PUMPS — TABLE NO. 1
FOR HEADS FROM 5 TO 36 FEET AND CAPACITIES FROM 15 TO 3000 G.P.M.
HEAD PER STAGE IN FEET

G.P.M.	5	6	7	8	9	10	11	12	14	16	18	20	22	24	26	28	30	33	36
15	2069	1769	1576	1428	1305	1206													
20	2343	2046	1816	1647	1505	1392	1298												
25	2660	2284	2050	1842	1633	1557	1451	1359											
30	2870	2501	2234	2018	1843	1705	1589	1486	1324										
35	3099	2701	2401	2179	1990	1841	1716	1604	1429	1296									
40	3314	2889	2568	2330	2129	1969	1835	1716	1529	1384									
45	3515	3064	2724	2471	2258	2089	1946	1820	1621	1468	1344								
50	3706	3230	2871	2605	2379	2201	2052	1918	1708	1547	1417								
55	3890	3388	3011	2732	2496	2309	2152	2012	1793	1623	1486	1373							
60	4067	3537	3144	2852	2606	2411	2247	2100	1871	1696	1551	1434	1335						
66		3683	3274	2970	2715	2510	2339	2187	1949	1764	1614	1493	1390						
70		3821	3396	3082	2816	2604	2427	2269	2022	1830	1674	1549	1442	1348					
75		3956	3515	3189	2915	2695	2512	2348	2092	1894	1735	1603	1492	1398	1318				
80		4082	3628	3292	3008	2782	2593	2424	2160	1955	1791	1655	1541	1444	1361	1289			
90			3851	3496	3195	2953	2752	2573	2292	2075	1901	1756	1635	1532	1444	1363			
100			4060	3684	3365	3113	2901	2713	2418	2188	2004	1852	1724	1615	1523	1437	1225		
110				3861	3527	3263	3041	2843	2535	2293	2100	1940	1806	1693	1596	1506	1418		
120				4035	3684	3409	3177	2970	2646	2395	2194	2027	1887	1768	1667	1573	1494	1391	1303
130				4199	3836	3549	3306	3092	2755	2494	2284	2111	1965	1841	1736	1638	1556	1448	1357
140					3981	3685	3432	3208	2859	2588	2370	2190	2039	1911	1801	1699	1615	1503	1408
150					4123	3814	3555	3323	2961	2680	2455	2268	2112	1979	1865	1760	1672	1557	1458
175						4118	3838	3588	3197	2894	2651	2449	2280	2137	2014	1901	1806	1681	1574
200							4102	3835	3417	3093	2833	2617	2437	2286	2152	2031	1930	1796	1682
225								4068	3625	3281	3006	2778	2586	2425	2284	2155	2048	1906	1785
250									3821	3459	3168	2927	2725	2556	2407	2272	2158	2009	1882
275									4006	3626	3322	3069	2857	2678	2524	2382	2263	2106	1973
300									4186	3789	3470	3207	2986	2798	2637	2488	2364	2201	2061
325										3944	3612	3338	3108	2912	2745	2590	2461	2290	2145
350										4070	3746	3462	3223	3020	2847	2686	2552	2375	2225
375											3850	3586	3381	3128	2948	2782	2643	2460	2305
400											4008	3703	3448	3230	3045	2878	2730	2541	2380
450											4250	3928	3656	3428	3229	3048	2895	2695	2524
500												4149	3854	3612	3404	3213	3052	2841	2661
550													4042	3788	3570	3369	3201	2980	2791
600														3957	3730	3520	3344	3112	2915
650														4118	3882	3663	3480	3239	3034
700															4028	3801	3611	3361	3148
750															4176	3934	3738	3479	3259
800																4069	3866	3594	3366
850																	3988	3704	3469
900																	4095	3812	3570
950																		3916	3668
1000																		4018	3763
1100																			3947
1200																			4122
1300																			

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Ns FOR 1750 RPM DEEPWELL CENTRIFUGAL PUMPS — TABLE NO. 2
FOR HEADS FROM 40 TO 130 FEET AND CAPACITIES FROM 140 TO 8000 G.P.M.
HEAD PER STAGE IN FEET

G.P.M.	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130
140	1302																		
150	1349	1238																	
175	1456	1331																	
200	1556	1423	1316																
225	1651	1509	1397																
250	1740	1591	1472	1370															
275	1825	1668	1543	1436	1340														
300	1906	1743	1612	1500	1400	1308													
325	1984	1814	1678	1562	1458	1379	1303												
350	2058	1881	1741	1620	1512	1430	1351	1280											
375	2131	1949	1803	1678	1566	1481	1400	1325											
400	2202	2013	1862	1733	1617	1530	1446	1370	1309										
450	2335	2134	1975	1837	1715	1622	1533	1459	1388	1325									
500	2461	2250	2082	1937	1808	1710	1616	1538	1463	1397	1338								
550	2581	2360	2183	2031	1896	1793	1695	1613	1535	1465	1404	1350							
600	2697	2465	2281	2122	1981	1873	1770	1685	1603	1530	1466	1410	1355	1308					
650	2807	2566	2374	2209	2061	1950	1843	1754	1669	1593	1526	1468	1410	1361	1316				
700	2912	2662	2463	2292	2139	2023	1912	1820	1732	1653	1583	1523	1465	1413	1366	1326			
750	3014	2755	2549	2372	2214	2096	1979	1883	1792	1711	1639	1577	1516	1462	1414	1371	1333		
800	3114	2846	2633	2450	2287	2163	2044	1945	1851	1767	1693	1628	1564	1510	1460	1416	1376	1322	
850	3209	2934	2714	2525	2357	2230	2107	2005	1908	1821	1745	1679	1612	1556	1505	1459	1418	1362	1317
900	3302	3019	2793	2599	2426	2296	2168	2063	1964	1874	1796	1727	1659	1601	1549	1502	1459	1402	1356
950	3393	3102	2870	2670	2492	2357	2228	2120	2017	1926	1845	1775	1705	1645	1591	1543	1499	1440	1392
1000	3481	3182	2944	2739	2556	2418	2285	2175	2069	1975	1892	1820	1748	1688	1632	1583	1537	1477	1429
1100	3651	3337	3088	2873	2681	2536	2397	2281	2171	2072	1985	1910	1834	1770	1712	1660	1612	1550	1499
1200	3813	3486	3225	3000	2801	2649	2504	2382	2267	2164	2073	1994	1916	1849	1788	1734	1683	1619	1567
1300	3969	3628	3357	3123	2915	2757	2606	2480	2360	2253	2158	2076	1994	1925	1861	1805	1748	1683	1629
1400	4124	3770	3488	3245	3029	2865	2708	2577	2452	2340	2242	2157	2073	2000	1934	1875	1819	1750	1692
1500		3906	3614	3364	3140	2969	2808	2673	2543	2427	2327	2237	2151	2076	2006	1944	1888	1817	1756
1650		4083	3781	3519	3285	3107	2936	2796	2659	2538	2432	2339	2247	2169	2097	2033	1972	1898	1836
1800			3938	3675	3430	3244	3066	2918	2777	2650	2539	2442	2346	2264	2189	2123	2059	1982	1916
2000			4163	3874	3616	3420	3232	3076	2927	2794	2676	2575	2473	2387	2309	2238	2169	2090	2020
2200				4063	3792	3587	3390	3226	3070	2930	2807	2700	2596	2503	2421	2347	2276	2192	2119
2400					3961	3746	3541	3369	3206	3061	2932	2821	2709	2615	2529	2452	2376	2289	2211
2600					4122	3898	3685	3507	3337	3186	3052	2936	2820	2722	2632	2552	2473	2382	2300
2800						4047	3826	3639	3465	3306	3167	3047	2926	2824	2732	2648	2566	2472	2388
3000						4189	3959	3767	3588	3422	3278	3153	3029	2923	2828	2741	2655	2559	2473
3200							4088	3890	3702	3534	3385	3257	3128	3019	2920	2831	2742	2643	2553
3500								4066	3870	3694	3539	3406	3270	3156	3053	2950	2855	2753	2659
4000									4138	3950	3784	3640	3495	3374	3263	3143	3053	2934	2836
4500										4189	4013	3860	3708	3579	3461	3336	3238	3112	3008
5000												4070	3908	3772	3646	3537	3433	3300	3196
5500													4099	3956	3827	3711	3581	3446	3338
6000														4132	3998	3875	3759	3618	3507
6500															4161	4034	3914	3764	3647
7000																4186	4059	3909	3786
7500																	4180	4044	3916
8000																		4077	4041

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Tables for Ns Values for Various Pumping Capacities and Heads—Deep Well Pumps

small communities, and while the water levels lower, they recover rapidly, and since the distance from the outcrop to the wells is small, the time to replenish the depletion is shortened.

Precipitation is essentially uniform from year to year, and the amount of rainfall in humid and semi-humid sections is sufficient for human needs. A forty acre cornfield consumes as much water in a good season as a town of 3,000 people using water at the rate of 15 gallons a day per person. It cannot be argued that such a crop robs the ground water supply, since its thirst is satisfied from a depth of not more than seven feet in the earth.

It is true that some of the wild grasses have root systems that extend down twenty feet, but it cannot be said that this condition affects the ground water level.

Industrial water requirements in many instances are very heavy, and when a fairly large city composed of many workers must, besides furnishing a domestic water supply, also supply well water for a great number of factories, the pumping level will naturally be deep. Frequently industrial plants have their own well water supply and if no consideration is given to interference due to closely grouped wells, the water table throughout a considerable area will be seriously affected. This seems to be the condition prevailing in the Eastern section of the United States and to a large extent in the Midwest.

The Southwestern area of the country and a large portion of the Southwest coast lie in what is considered the arid and semi-arid zones. Unless precipitation, which is not sufficient for agriculture, is augmented by artificial irrigation, a large portion of the West would still be desert-like in character. Were it not for groundwater supplies and deep well pumps, the wonderful industrial development which is so dependent upon agricultural prosperity would indeed be nonexistent.

The West Responsible for Much Deep Well Progress

In no other section of the world will you find people of every walk in life so water-conscious as in the Southwestern United States. It is a fair assumption that in California alone you will find more water wells per square mile than in any other place on the globe. To the West and Southwest is due most of the credit for progress in improved well construction and for pump refinement developments of recent years.

Their water conservation laws and well construction regulations are the result of many years of practical experience, and while they are peculiarly adapted to the geological characteristics of their section, these laws and regulations can be of use as guides in the making of rules for the Midwest and East. Some of the states in these latter sections have completed legislation on the subject, with major emphasis directed towards some degree of control over well water supplies for industry as well as for municipalities.

Looking Ahead at Possibilities When Developing Well Supplies

Until the time arrives when water supply from wells can be controlled by regulation of industrial density, deep well centrifugal pumps should be selected which will under existing conditions serve the user over a long period before extension of the pump column becomes necessary.

In a previous paper in the November, 1944, issue of *Water Works and Sewerage*, the writer presented "A Method of Selecting Deep Well Centrifugal Pumps" to attain optimum efficiencies. It was explained by graphs and examples how deep well pumps that operated at a specific speed of approximately 2,500 per stage would, because of high efficiency, warrant the extra first cost of wells for such pumps. Now it is the

TABLE NO 3

N_s FOR 1170 RPM DEEP WELL CENTRIFUGAL PUMPS
FOR HEADS FROM 10 TO 40 FEET AND CAPACITIES FROM 50 TO 3200 G.P.M.

HEAD PER STAGE IN FEET

GPM.	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34	36	38	40
50	1472	1371																	
60	1612	1500	1404	1322															
70	1741	1623	1517	1428															
80	1862	1735	1622	1527	1445	1373													
90	1976	1840	1721	1619	1533	1456	1388												
100	2086	1940	1814	1707	1616	1535	1463												
110	2189	2036	1902	1790	1694	1610	1539	1403											
120	2288	2128	1989	1870	1770	1682	1608	1466	1356										
130	2383	2216	2067	1946	1842	1750	1673	1527	1411										
140	2463	2295	2146	2020	1912	1816	1736	1585	1465	1363									
150	2549	2376	2221	2091	1979	1880	1797	1641	1516	1411	1328								
160	2630	2452	2294	2159	2043	1941	1855	1694	1565	1457	1370								
170	2708	2525	2364	2225	2105	2000	1911	1746	1613	1502	1413	1329							
180	2783	2595	2430	2288	2165	2057	1966	1796	1659	1545	1453	1367	1292						
190	2856	2663	2494	2349	2223	2112	2019	1844	1704	1587	1493	1404	1328						
200	2926	2729	2556	2407	2278	2165	2069	1890	1747	1627	1530	1440	1362	1296					
210	2994	2793	2617	2464	2332	2217	2119	1936	1789	1667	1567	1475	1396	1328					
220	3060	2855	2676	2520	2386	2268	2168	1981	1831	1706	1604	1510	1429	1360					
230	3124	2915	2733	2573	2437	2317	2215	2024	1871	1744	1640	1544	1462	1391	1328				
240	3186	2974	2788	2626	2487	2365	2261	2067	1910	1781	1675	1577	1494	1422	1358				
250	3247	3031	2842	2678	2536	2412	2306	2108	1949	1817	1709	1610	1525	1452	1387				
260	3306	3086	2895	2728	2584	2457	2350	2148	1986	1852	1742	1641	1555	1481	1415	1355			
270	3365	3140	2947	2777	2631	2502	2393	2188	2023	1887	1775	1672	1585	1509	1442	1381			
280	3422	3194	2998	2825	2677	2546	2436	2228	2060	1922	1808	1703	1615	1538	1469	1408	1352		
290	3478	3247	3048	2872	2722	2590	2478	2267	2096	1956	1840	1734	1644	1566	1496	1434	1377		
300	3533	3299	3097	2919	2767	2633	2519	2305	2132	1989	1871	1763	1672	1593	1522	1459	1402	1349	
310	3587	3350	3145	2965	2811	2675	2560	2342	2166	2022	1902	1792	1700	1620	1548	1484	1426	1373	
320	3640	3400	3192	3010	2854	2717	2600	2379	2200	2054	1932	1821	1727	1646	1574	1509	1450	1396	1347
330	3692	3449	3238	3054	2897	2758	2640	2416	2234	2086	1962	1850	1755	1672	1599	1534	1474	1419	1369
340	3743	3497	3284	3098	2939	2799	2679	2452	2268	2118	1992	1879	1783	1699	1625	1559	1498	1443	1392
350	3794	3545	3329	3142	2980	2839	2718	2488	2302	2150	2023	1908	1811	1726	1651	1584	1522	1466	1415
360	3844	3592	3374	3185	3022	2879	2757	2524	2335	2182	2053	1937	1838	1753	1677	1609	1546	1490	1438
370	3893	3639	3419	3228	3063	2919	2795	2560	2369	2214	2083	1966	1866	1780	1703	1634	1571	1514	1461
380	3942	3685	3463	3270	3104	2958	2833	2595	2402	2245	2113	1995	1894	1807	1729	1659	1596	1538	1485
390	3990	3730	3506	3312	3145	2997	2871	2630	2435	2276	2142	2023	1921	1833	1754	1684	1620	1562	1508
400	4038	3774	3549	3353	3185	3036	2908	2665	2467	2306	2171	2050	1947	1858	1778	1708	1643	1585	1530
450		4015	3847	3634	3451	3288	3149	2886	2671	2496	2350	2220	2108	2012	1925	1849	1779	1716	1657
500			4055	3877	3683	3508	3360	3078	2849	2663	2507	2368	2248	2146	2053	1972	1898	1830	1768
550				4098	3879	3694	3538	3241	3000	2803	2639	2493	2367	2259	2161	2076	1998	1926	1861
600				4141	3958	3760	3586	3281	3032	2833	2668	2473	2353	2285	2130	2052	1949	1871	1893
650					4119	3914	3727	3405	3454	2938	2358	2595	2449	2327	2217	2115	2028	1948	1876
700						4061	3869	3544	3275	3049	2857	2692	2541	2444	2301	2195	2105	2021	1947
750							4005	3669	3390	3150	2951	2781	2631	2499	2382	2272	2179	2092	2015
800							4136	3789	3501	3259	3054	2877	2721	2581	2460	2346	2250	2161	2081
850								3906	3609	3366	3158	2973	2811	2666	2540	2423	2324	2227	2146
900								4019	3714	3457	3260	3069	2902	2752	2621	2500	2398	2298	2212
950									3815	3552	3329	3137	2966	2813	2681	2557	2452	2355	2268
1000									3915	3643	3415	3219	3036	2886	2707	2623	2514	2414	2327
1100									4105	3822	3582	3376	3184	3027	2885	2751	2639	2534	2441
1200										3992	3741	3526	3327	3163	3013	2873	2756	2647	2549
1300										4155	3893	3670	3463	3290	3134	2991	2869	2755	2653
1400											4046	3814	3599	3419	3259	3108	2981	2862	2756
1500											4182	3992	3726	3539	3369	3212	3081	2959	2850
1650												4155	3901	3705	3529	3378	3232	3104	2990
1800													4038	3832	3650	3519	3375	3240	3122
2000														4081	3890	3710	3559	3417	3291
2200															4080	3891	3732	3589	3462
2400																4063	3896	3743	3605
2600																	4057	3896	3752
2800																		4043	3896
3000																		4139	4011
3200																			4163

TABLE NO 4

N_s FOR 1170 RPM DEEP WELL CENTRIFUGAL PUMPS
FOR HEADS FROM 45 TO 140 FEET AND CAPACITIES FROM 400 TO 8000 G.P.M.

HEAD PER STAGE IN FEET

GPM.	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	140
400	1365																		
450	1427	1320																	
500	1504	1392																	
550	1578	1460	1358																
600	1648	1525	1419																
650	1715	1587	1476	1378															
700	1780	1647	1532	1430	1352														
750	1842	1704	1586	1480	1400														
800	1903	1760	1638	1529	1446	1366													
850	1961	1815	1688	1576	1491	1409													
900	2018	1867	1737	1622	1534	1450	1379												
950	2073	1918	1785	1666	1576	1489	1417	1348											
1000	2128	1968	1832	1709	1617	1528	1454	1384											
1100	2231	2064	1921	1793	1696	1603	1526	1451	1385										
1200	2330	2156	2006	1872	1771	1674	1593	1516	1447	1386									
1300	2425	2244	2088	1949	1843	1742	1657	1578	1506	1443	1388	1339							
1400	2520	2332	2170	2025	1915	1810	1723	1639	1565	1499	1442	1385	1337						
1500	2605	2410	2243	2093	1980	1871	1781	1695	1618	1550	1491	1432	1382	1337					
1650	2733	2529	2353	2196	2077	1963	1868	1778	1697	1626	1564	1502	1450	1402	1360				
1800	2859	2641	2457	2293	2169	2050	1951	1856	1772	1698	1633	1568	1514	1464	1420	1370			
2000	3019	2784	2590	2417	2286	2161	2056	1957	1868	1789	1721	1653	1596	1543	1496	1444	1397	1360	
2200	3155	2919	2716	2536	2398	2266	2157	2052	1959	1877	1805	1734	1674	1619	1569	1514	1465	1427	1359
2400	3296	3049	2837	2648	2505	2367	2252	2144	2046	1960	1886	1811	1748	1691	1639	1582	1530	1490	1418
2600	3430	3176	2953	2756	2607	2464	2344	2231	2130	2040	1963	1885	1820	1760	1706	1646	1593	1551	1467
2800	3560	3293	3064	2862	2706	2557	2433	2315	2210	2117	2037	1956	1889	1826	1771	1709	1653	1610	1523
3000	3685	3409	3172	2961	2800	2647	2518	2397	2288	2192	2108	2025	1954	1890	1833	1769	1711	1666	1576
3200	3806	3521	3276	3058	2892	2733	2601	2475	2363	2264	2177	2091	2019	1952	1893	1826	1767	1721	1628
3500	3980	3682	3426	3198	3025	2859	2720	2589	2471	2367	2277	2187	2111	2042	1980	1910	1848	1799	1703
4000	4255	3937	3663	3419	3234	3056	2908	2768	2642	2531	2435	2338	2257	2183	2116	2042	1976	1924	1821
4500		4175	3885	3626	3430	3241	3084	2935	2802	2684	2582	2480	2394	2315	2245	2166	2095	2040	1931
5000			4095	3822	3615	3417	3251	3094	2953	2829	2722	2614	2523	2440	2366	2283	2209	2151	2035
5500				4009	3791	3584	3410	3245	3098	2967	2855	2742	2646	2560	2482	2395	2317	2256	2134
6000					3960	3743	3562	3389	3235	3099	2982	2864	2764	2674	2592	2501	2420	2356	2229
6500					4122	3895	3707	3528	3367	3226	3103	2981	2877	2783	2698	2603	2518	2453	2320
7000						4046	3847	3661	3495	3348	3221	3093	2985	2888	2800	2702	2614	2545	2408
7500							3982	3789	3617	3465	3334	3202	3090	2989	2897	2796	2705	2634	2493
8000								3914	3736	3579	3443	3307	3192	3087	2993	2888	2794	2721	2574

Tables for Ns Values for Various Pumping Capacities and Heads—Deep Well Pumps

intention to show that pumps of this specific speed and under also have desirable suction characteristics of great importance when ground water levels are receding.

Deep well centrifugals are generally sold under a guaranty based on conditions wherein the water level when pumping is above the lowest impeller. In a way this infers that pumps will not operate satisfactorily if the water stands below the impeller. This seeming paradox resembles somewhat the real paradox of the bumble bee, which from an aerodynamic point of view cannot fly but does.

It is true that some deep well centrifugals will not operate unless flooded, but it is the intention to consider how in view of water level recession in wells, savings in pump column additions can be affected by the use of pumps with a specific need (Ns) of approximately 2,500. It is the intention to show that pumps operating at approximately this specific speed will, when necessary, because of their design, operate with water levels considerably below the pump proper, provided sufficient suction pipe is used. This latter characteristic will make it unnecessary to pull a pump and add suction column as frequently as might be the case with pumps of higher specific speeds (Ns).

Commercial Significance of "Specific Speed"

The commercial significance of the term "specific speed" is very real and is a key to the proper selection of deep well centrifugal pumps. The technical definition of specific speed and the part it plays in design will be neglected, since the subject under consideration is that of selecting from a group of standard commercially designed pumps (of various specific speeds) that one best suited for a particular hydraulic condition.

"Specific Speed" is not the capacity of a pump, nor its head per stage, nor the revolutions per minute, but it is these three variables combined in a proper manner and expressed in one term.

Just as the letters of an alphabet combine to make words, so the three variables—capacity, head, and speed—are the components of equations which evolve the term "Specific Speed," commonly referred to as Ns value.

Small values of Ns are indexed to pumps of relatively high head per stage for a given capacity and operating at medium or low revolutions per minute. The impellers of such pumps are narrow in width, when compared to their diameter, and the impeller suction inlet diameter is also comparatively small.

Large values of Ns, in contrast with the foregoing, apply to pumps of low head for given capacity and operating at medium or high revolutions per minute. The impeller widths are essentially great and the impeller suction inlet diameter is relatively large.

The phenomenon of whirling waters exemplified in the centrifugal pump impeller follows laws which defy strict mathematical definitions or analysis. Because of this it is necessary to modify known laws by empirical factors derived from tests, or found in the field of practice. One of the several characteristics is that of suction performance, which is dependent upon atmospheric pressure. Many tests have provided empirical factors for various design types and from these data suction performance can be determined.

Impeller Characteristics and Lift Capacities

Turn for a moment to Sketch No. 1, illustrating an impeller of low Ns, and you will note that the diameter of the impeller is considerably larger than the so-called eye of the impeller, through which all the water must enter. The blades that "bite" into

the fluid at the eye extend themselves to the outside diameter of the impeller and in doing so form long channels that guide the outward flowing streams through smooth tunnels. Such proportions are conducive to high suction lifts, which means, of course, that such an impeller will successfully and efficiently pump when the water level is well below the pump. In a way it can be imagined that long channels have a firmer grip on the flowing water and using a common expression, they will "pull water" from considerable depths.

Looking at Sketch No. 2, representing a high Ns impeller, we see a large eye in comparison with the diameter and blades forming short channels. This condition does not favor pumping from considerable depths below the impeller; and, in some hydraulic duties, this type of impeller requires water under a positive head at the eye in order to pump efficiently.

It must be remembered that regardless of the Ns value, all centrifugal pump bodies must be filled with water at the start of operation.

Because of the limits imposed by atmospheric pressure, the maximum distance which water can be lifted is theoretically 33⅓ feet at sea level. Friction losses, the energy required to move water and other factors, limit the maximum lift to about 25 feet. But this maximum lift can be realized when certain speeds are employed. Within the limits determined by the particular type and design, greater amounts of water can enter a pump with an increase of shaft revolutions. The upper limits on this behavior are reached when the water is considerably below the pump. Every foot of lift below the impeller reduces the net atmospheric pressure available for forcing water into the impeller eye. There comes a condition near the high suction lift region where the inlet velocity to the impeller can no longer, because of low absolute pressure, support an increase in capacity regardless of the revolutions per minute of shaft.

How "Specific Speed" is Determined and Ns Values Tabulated for Ready Use

Throughout this article "specific speed" has been mentioned frequently and means for determining this value will now be presented.

The formula used to derive the "specific speed" is expressed as follows:

$$Ns = \frac{\sqrt{GPM} \times RPM}{H^{\frac{3}{4}}}$$

$$\text{or } Ns = \frac{RPM}{\sqrt{H}} \sqrt{\frac{GPM}{\sqrt{H}}}$$

In commercial work, however, it is not desirable to complicate procedure by lavish use of formulas and especially not with mathematical expressions involving odd roots or powers.

Since the value Ns is considered of prime importance (and is, in fact, the crux of this article), values of Ns have been calculated and set up in table form. Two sets of tables are presented for 1,750 rpm. (see Tables 1 and 2) and one for 1,170 rpm. (see Tables 3 and 4). These cover the two 60 cycle speeds, but a comprehensive set of similar tables could be prepared for various other speeds, and the limits on head and capacity as shown on these representative tables could be extended to any values desired.

The data on sales density, as derived from an analysis of at least 10,000 transactions, indicates that from 70 to 80 per cent of all deep well centrifugal pumps installed in the United States are of the capacity and head per stage covered in these four tables.

By inspection of Tables 1-2-3-4 it will be seen that the head and capacity are graduated in determined values. Specific speed values are determined by finding the capacity in question on the left side of the table and moving across horizontally until the vertical column showing the head in question is reached. In the square in this particular head column on line with the capacity value will be found the specific speed (Ns) for that capacity, head and rpm. under consideration. Specific speeds for conditions not specifically listed can be found by interpolation so long as these are within the limits of the tables.

These tables cover Ns values between a low limit of essentially 1,300 and a high of practically 4,100. This range has been found suitable for deep well pumps of the centrifugal type. Occasionally hydraulic duties are encountered indicating Ns values outside these limits. Such cases require pumps of special design and construction.

Analysis Charts for Pumping Problems

The majority of deep well centrifugal pumps problems can be analyzed for suction performance through the use of Chart No. 3 when values of Ns and head per stage have been assumed. To illustrate let us consider the permissible suction conditions for two unrelated and independent cases with respect to Ns and head only:

Case No. 1. Ns = 2,000 and head is 50 feet per stage. From Chart No. 3 it is seen that a pump fulfilling these values will operate when the water level is 20 feet below the bottom impeller without danger of cavitation. (See footnote—Ed.)

Case No. 2. Ns = 3,500 and 110 feet per stage. Chart No. 3 for this condition indicates that the water level when pumping must stand at least 15 feet above the lowest impeller in order to insure efficient non-cavitation performance.

In a city water works or an industrial installation or any prospective deep well supply, where progressive water level recession is anticipated, pumps with proper characteristics can be obtained that mitigate the annoyance due to inevitable changing well conditions.

Case No. 1 and Case No. 2 were concerned only with Ns and head per stage. Pump selection for favorable suction characteristics can best be shown by a concrete example that confines the choice to two pumps, either one capable of delivering 1,650 gpm. against a head of 250 feet.

Good practice indicates that pumps for this capacity can operate at either 1,170 or 1,750 rpm.

An 1,170 rpm. unit can be termed a Class "A" pump and is preferred because the diameter of this class of pumps insures water passages with smooth flow lines and easy curvature. Five stages can be employed, each stage generating 50 feet. From the specific speed tables the Ns is indicated as 2,510 and this value for 50 feet per stage on Chart No. 3 indicates that the pumping water level can recede 18 feet below the bottom impeller before column extension is necessary. The diameter of such a pump is determined from Chart No. 1.

A pump of 1,750 rpm. for the hydraulic duty mentioned can be of the Class "C" design wherein the pump proper is held to a relatively small diameter (see Chart No. 2). Five stages, each one generating 50 feet head at 1,750 rpm., result in an Ns value of 3,780. From Chart No. 3 it is seen that the pumping level can recede to only 8 feet below the lowest impeller before the threshold of cavitation is reached. Any further recession will affect the performance. Assuming that the water level recedes at the rate of 3½ feet per year,

[Ed. Note: Cavitation, indicated by sounds like shot passing through the pump casing, has been frequently assumed to be due to small air bubbles traveling under high speed. To the contrary, cavitation is evidence of vacuum within the pump.]

it appears that before suction column extension is necessary, the large diameter slow speed pump (1,170 rpm. and Ns 2,510) will operate two years and three months longer than the higher speed (1,750 rpm. and Ns 3,780) small diameter pump.

In some sections the recession rate is greater than 3½ feet per year and naturally the analysis will indicate a different period of operation before column extension becomes necessary. It is realized that if the primary installation is deep enough, the critical period for column extension may be reached at the time when replacements either due to wear or obsolescence are necessary. This is true regardless of type.

Unfortunately many pumps are sold with the major emphasis on first cost, and since a good proportion of cost is in the column, short settings are the rule rather than the exception.

Aside from potential submergence problems, another important feature must be recognized. In quite a few instances the upper well casing or pit, wherein the pump is located, has been impaired by corrosion. An internal liner is often set within the well casing to seal against leakage into the well from undesirable strata. The liner reduces the net diameter of the well pit, forcing the use of a smaller pump. If the primary diameter is small, the use of a liner may necessitate a reduced capacity pump, or mixed flow pump, of high Ns and low head per stage. A great number of stages then become necessary, and such a pump has characteristics different from the centrifugal which may require a motor fitted with an extra high capacity thrust bearing.

Summary

It is believed that if more attention is centered on selecting pumps of preferential diameter, set at favorable depths, deep well pumps will, because of better performance, add to the economic welfare of both the owner and the manufacturer.

Albert Heard Passes

Served Hagerstown Water Utility 58 Years; Sup't. 55 Years. Assisted in Introduction of Scientific Chlorination Control.

Another of the old line water utility operators left us when on March 4th, 1945, Albert Heard, Sup't. of the Hagerstown, Md., Water Department, passed away at the age of 84, after a brief illness.

Albert Heard

Mr. Heard went to work with the Washington County Water Co. in 1887 as assistant superintendent and then years later became superintendent which position he held for 55 years for a total service period of 58 years in the Hagerstown Water Works, which since 1918 has been municipally owned. He was born in Hagerstown and operated a plumbing business before joining the local Water Company when it had 200 customers as against the 8,500 connections of today.

Mr. Heard, whom the writer got to know about 1915, was a rather remarkable water works manager—what we call "a born water works man." So highly was he thought of by the City Administration that the mayor ordered the closing of the City Hall during the afternoon of his funeral.

We particularly remember Mr. Heard for his interest in any advance in water works practice and his readiness to adopt modern methods. It was in 1915 that Abel Wolman and this writer picked the Hagerstown Water Supply as the guinea pig on which to try out our newly discovered scheme of chlorination control by use of the orthotolidin test for residual chlorine and adjustment of the chlorine dosage to maintain a positive residual within the range of 0.1 to 0.2 parts per millim. At that time we had only surmised the efficiency of this newly conceived control method but in Mr. Heard we found a willing listener and a friend who was as anxious to test our new scheme as were we. Pleasingly enough the scheme proved practical and simple—it really worked. So it was Mr. Heard who helped to put the residual chlorine dosage control on the map through his interest and cooperation as did J. S. Patrick at Luke, Md.—then a very young chemist in the laboratories of the West Va. Pulp and Paper Co. Yes at Hagerstown and Luke, Md. in 1915 and 1916 was seen the very beginning of the method for the control of chlorination of water which has since spread around the world.

Richard Willson Appointed Superintendent of Hagerstown Water Department

Another Chemist Receives Deserved Recognition on Basis of Proven Ability.

To the position of Water Department Superintendent at Hagerstown, Md., vacated by the death of Mr. Albert Heard, after 58 years of service, Richard C. Willson was promptly appointed by the Mayor and the Board of Water Commissioners.

Some eight years ago Mr. Willson was employed as Chemist in Charge of Filtration and the record of water quality since has received the attention of the State Dept. of Health and in turn the Board of Water Commissioners. In addition to his record as chemist, Mr. Willson has been handling many of the duties of the Superintendent during recent years of failing health of Mr. Heard.

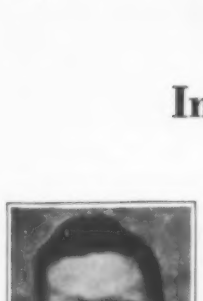
Richard C. Willson

Mr. Willson, the tallest member of the Md.-Delaware Water and Sewage Assn., is a graduate of Mt. St. Mary's College (Md.). Before going to Hagerstown he was a junior sanitary engineer with the Md. State Dept. of Health. He will continue to give close supervision to the filtration plant while assuming the administrative duties of General Superintendent.

One time the lowly chemist had little in view beyond his job in charge of purification, and such recognition and appointments as that of "Dick" Willson to us makes grand reading. Chemists who can develop the needed executive ability can now look forward to becoming managers via the career route. That is reassuring indeed to the young man entering the water supply business.

WESTERN SECTION NYSSWA HOLDS REGULAR SPRING MEETING

Improved Type Incinerator Featured on Program



Section Officers

Chairman
George Ledford
Operator
Niagara Falls, N. Y.

Secretary
Channel Samson
Supt.
Town of Tonawanda N. Y.

"THERE is more than one way to skin a cat," according to the old adage. And there is at least one way for water and sewage works associations to maintain their activities in spite of wartime restriction of travel and hotel occupation. And "that one way" is to hold sectional meetings. For associations that have active sections this is a simple matter. Such a fortunate organization is the New York State Sewage Works Association with five sections, which have, for several years, held regular sectional meetings throughout the year.

First of these sections to hold its regular Spring Meeting, this year, was the Western Section comprising eight counties in the western part of the state. Meeting in Kenmore, N. Y. on Sat., April 28, this group which boasts over a hundred members had an attendance of 62. Hosts at the meeting were Alexander Martin, Supt. of Public Works for the Town of Tonawanda (embracing the Village of Kenmore) and Channel Samson, Supt. of Sewage Treatment for the Town.

Among the persons attending were Frank E. Moore, Comptroller for the State of New York, Roy Brockett, Town Supervisor, other members of the Town Council, and municipal officers from nearby villages, as well as operators, superintendents, chemists, and manufacturers' representatives from all over the eight counties.

Mathematics of Sewage Treatment

In opening the session, George Ledford, Chairman of the section and an operator at the Niagara Falls Sewage Plant, welcomed the group and pointed out that the section had met in the same place five years ago and had, since that time held at least three meetings each year all in different locations, thus demonstrating that there is a need and a place for sectional meetings.

The program proper was conducted by I. O. Lacy, Supt. of Sewage Treatment at Lockport, N. Y. The first paper was read by **Leo Studebaker,** Chemist, Niagara Falls Sewage Treatment Works, on the subject of **"Mathematics of Sewage Treatment."** Mr. Studebaker was pinch-hitting on short notice for Vic Haemerline, Supt. of Treatment at East Aurora, who was hospitalized but a few days before.

Included in the chalk-talk by Mr. Studebaker, was an explanation of parts per million, how to calculate pounds per day, and the reasons for proportional sampling. The speaker also discussed the conversion of flow in mgd. to cfs., per capita load in pounds per day, population equivalents, per cent reductions or removals and how to compute them, as well as per cent volatile matter, per cent digestion, and various methods of reporting bacteria in sewage.

Programmers

N. L. Nussbaumer
Cons. Engr. and
Dir. Public Wks.
Buffalo, N. Y.

Robt. S. Rowen
Chief Engineer
Nichols Eng. Corp.
New York, N. Y.

In the matter of calculating the most probable number of coliform bacteria in sewage, Mr. Studebaker proposed the following formula:

$$\text{M.P.N. per ml.} = \sqrt[x]{yz}$$

where x = no. of positive tubes
y = vol. of water in negative tubes
z = vol. of water in all tubes

but this formula can be used only in a three tube series.

Town of Tonawanda Treatment Works

Since the last time the Section met in the Town of Tonawanda additions to the sewage plant have been made and as a prelude to the inspection trip, Channel Samson, Sup't, reviewed the history of the plant and its development.

The original plant designed for 10,000 population consisted of two radial flow Imhoff tanks and sludge drying beds. This plant was built in 1922 at a cost of $52,000. Five years later the capacity was increased to 22,000, with two more Imhoff tanks being added, along with a hand raked screen, and glass covered drying beds. Cost of this improvement was $75,000.

In 1930, at a cost of $10,000, the screen chambers were improved, an effluent wier was installed and post-chlorination added. Four years later $1500 were expended to install equipment that provided for pre- as well as post-chlorination and chlorination of storm flows, which were bypassed. Thereafter, odor control was better, the effluent was improved, while chlorine consumption was reduced.

In 1939-40 two digesters were installed, along with a laboratory, office, gas boiler, and a comminutor. At the same time the Imhoff Tanks were changed to plain settling tanks with sludge collecting mechanisms. The cost of these additions was $95,000 and the work was financed by PWA. Capacity of the plant was then 35,000 but the rapid growth thereafter coupled with the influx of industry soon made it apparent that the digestion capacity was too small to act as storage tanks in the winter and the sludge bed capacity was likewise too small.

In 1943, more additions were made for $11,000 (an FWA grant); these included two new digesters, of 70,000 cu. ft. capacity, new sludge pumping facilities, 14,500 sq. ft. of additional sludge drying beds, insulated tank covers, and a sludge loader. In 1944, $6000 more

N.Y.S.S.W.A. Representatives

"Ed" J. Smith
Supt.
Niagara Falls,
N. Y.
(Federation Dir.)

"Al" G. Martin
Comm. Public Wks.
Town of
Tonawanda
(Member Ex. Com.)

were spent for minor changes and the construction of a scum burning furnace, to get rid of screenings and skimmings from the settling tanks.

For a total of $351,000, the Town of Tonawanda has a modern primary sewage treatment plant (with chlorination) capable of handling a population load of 70,000 persons. With a present population tributary of 40,000 and an industrial waste load of some 15-20,000, there is now some reserve capacity.

Mr. Sampson pointed out that for the total expenditure, the cost per capita (designed) was only $5.00 per thousand, which is quite reasonable. Studies made during operation showed that it pays to insulate the digestion tank for without that insulation it would have been necessary to purchase gas to obtain the heat required.

Increasing the rate of the sludge stirring mechanism in the sludge digestion tanks reduced the moisture content of the sludge, as well as reducing its volatile content (i.e., increased digestion.) Burning of skimmings and screenings has been successful although plans for alterations in the furnace are being made. This material amounts to 60 cu. ft. a week. After ignition with sludge gas it burns by itself with little odor. After the war it is proposed to install a vacuum sludge filter and incinerator.

Garbage Incineration

It so happens that in the Town of Tonawanda, the garbage incinerator is located next door to the sewage plant. It also so happens that the operation of the garbage incinerator is in the department of the Commissioner of Public Works, "Al" Martin, who likewise has the sewage plant under his wing.

Programmers

Leo Studebaker
Chemist
Niagara Falls, N.Y.

*Dr. Geo. E. Symons**
Assoc. Editor
Water Wks. & Sew.

*(*President, N.Y.S.S.W.A.)*

It is interesting to note that for the Town of Tonawanda the monthly load is fairly constant whereas in most other cities February pickups are low while August and September pickups are more than twice that of February.

Peak loads in the Town have gone over 50 tons on occasion but the incinerator had no difficulty in burning at above its rated capacity. Burning temperatures are kept at above 1200 deg. F. dropping slightly during charging. The temperature is recorded to give a record of operation. Ash amounts to approximately 12 per cent of the load.

It also so happens that the Town of Tonawanda had just completed an installation of a new 100-ton Monohearth Incinerator. And finally, it so happens that there are several other villages in the section where the garbage and sewage departments are twinned, or where there are tentative plans for new incinerators to be run in connection with the sewage department.

Thus it was to be expected that the program would contain two papers on this new development of **"The Monohearth Incinerator of the Town of Tonawanda."** The first of these two papers was presented by Newell L. Nussbaumer, Consulting Engr. of the firm of Nussbaumer and Clarke, who designed the new incinerator buildings and equipment.

The town area which has grown very rapidly during the past 25 years while Buffalo has grown very slowly, built its first incinerator in 1927 and added another furnace the next year. These furnaces were of the mutual assistance types, with drying and burning hearths, and required five men and considerable manual labor for stoking.

The new furnace has a charging floor above, reached by a ramp. Loads dumped here are pushed into the charging door by a small bulldozer. Stoking is done by mechanical stoking arms on the stoking floor. Gases are burned in a baffled combustion chamber after they leave the stoking chamber. Ashes are delivered to a cone beneath the hearth from whence, after wetting down, they are delivered to a truck for hauling to the dump.

Operation of the new plant is cleaner, more efficient, and needs but four men, who also have time enough to maintain both the buildings and the grounds.

In the second paper on this subject, **Robert S. Rowen,** Chief Engr. of the Nichols Engineering and Research Corp., New York, described **"The Construction of the Monohearth Incinerator,"** its parts, and its equipment, pointing out that one of the primary achievements of mechanical stoking was the great increase in combustion rates.

Other advantages of this type of furnace are the elimination of lost burning time during ash removal, elimination of spotty burning and air holes, reduction of excess air into the furnace. This particular incinerator was designed for a combined drying and burning rate of 112 lb. as compared with the usual 50 lb. rate, and the burning rate design was 216 lb. per sq. ft. compared to the usual 75 lb. rate for conventional incinerators.

Luncheon

Following a lunch reminiscent of the last one held in the YWCA, Host "Al" Martin introduced the visiting dignitaries and elicited from Mr. Frank E. Moore, Comptroller of the State of New York, a few words on post-war planning and the need for municipalities to proceed at once if they had not already done so. Mr. Moore also indicated that he expected there to be a considerable boom in construction after the war with some shortages continuing because of lack of sufficient production to meet the needs of long deferred maintenance and construction.

As President of the NYSSWA, Dr. George E. Symons, Associate Editor of *Water Works and Sewerage*, back in the section where he had served as Secretary and Chairman for several years, emphasized the need for continuing these section meetings particularly while war time restrictions prevent the holding of meetings of the parent body.

Dr. Symons mentioned that all five sections of the NYSSWA have scheduled meetings for this Spring; the Genesee Section in Lyons on May 5, the Long Island Section on May 23rd at Tallmans Island Plant, N. Y., the Capitol Section in Albany on June 15th and the Central Section in Syracuse on June 16th. At each of these meetings papers presented will be those that

Inspection of New 100-Ton Monohearth Incinerator

Group watching the back and time saving furnace charging bulldozer at work at the Tonawanda incinerator.

would have been scheduled for the regular June Meeting.

As President, Dr. Symons also exhorted the members of the Western Section to extend their membership to bring in more new members particularly many non-member licensed operators in the State of New York, and said he hoped that in the not too distant future, there would be a section in lower New York State, to include a large group of members of the NYSSWA not now having a sectional organization.

Inspection Trip

Following lunch, almost all of those attending the meeting visited the new Tonawanda incinerator and the sewage treatment plant. At the former the visitors were privileged to watch the charging of the incinerator, to view the burning hearth, the combustion chamber and the removal of ashes.

Group Inspecting Another Incinerator

This one burns screenings and skimmings from the tanks at the Tonawanda Treatment Plant.

At the sewage plant one of the most interesting sights was the burning skimmings in the open hearth furnace. The system of sludge sampling from any elevation in the sludge tanks was also of interest to the visitors as were the flexible sludge pumping system and the teletalk system for communicating from the sludge pumping section of the plant with the laboratory and office.

The Western Section plans to hold its regular September and November meetings this Fall. (G. E. S.)

C. L. Siebert Opens Consulting Office

Resigns from Sanitary Water Board of Penna.

Formal announcement has been received that Christian L. Siebert, has opened a private practice as a consulting engineer. Mr. Siebert who was formerly Executive Engineer in the

Pennsylvania Department of Health (Sanitary Water Board) in charge of industrial waste control, will specialize in the treatment of industrial wastes, investigations, analytical surveys, reports, plans, specifications, and supervision of operation. Mr. Siebert has located his office at 222 Willow Ave., Camp Hill, Penna.

New N.C.S.I. Pollution Study Project

The National Council for Stream Improvement of the Pulp, Paper and Paperboard Industries, Inc., has established a project at the Institute of Paper Chemistry at Appleton, Wis. This project will involve, mainly, aquatic biology and will be under the immediate supervision of Dr. Willis Van Horn, the Institute's biologist. Problems involving the effect of various types of mill wastes on fish life will be studied and means for preventing damage to fish will be developed. Experimental work will be carried on both at the Institute, which is well equipped for such work, and at mills where problems exist. A number of mills are, at present, carrying on similar work and most of these projects will be coordinated with the Institute's work through the Council.

Texas Manual for Sewage Works Operators

Now Under Development by Texas Water & Sewage Short School

Some years ago the Texas Waterworks and Sewerage Short School developed a worthy "*Manual for Waterworks Operators.*" In the course of production at this time is a "*Manual for Sewageworks Operators,*" which is the principal project of the Sewage Section of the Texas Short School under the personal direction of W. S. Mahlie, Supt. of Water and Sewage Treatment, Fort Worth, Tex., who has assumed the chairmanship of the Manual Committee.

At the 1945 meeting of the Texas Waterworks & Sewage Short School the Sewage Division elected the following officers:

Chairman—Major R. M. Dixion, U. S. Engrs., Dallas.

Vice Chairman—L. C. Billings, Supt. Water & Sewage Treatment, Dallas.

Secretary—V. M. Ehlers, State San. Engr., Austin.

The short school was conceived and founded by V. M. Ehlers 27 years ago and represents the first known educational effort toward training of water and sewage operators. The record Short School registration of better than 400 in 1944 speaks for itself. This writer recalls the time when an attendance of 40 was considered as justification for holding the School.

Charlie Eastwood Passes

On April 27th in Pasadena, Cal., the water works industry lost a friend when Charles H. Eastwood, Advertising Manager for Wallace and Tiernan, passed away from a heart attack.

Charlie Eastwood was born and educated in England, but came to Canada as a young man, serving in the Canadian Army in World War I. After some years with Nordyke and Marmon, builders of flour milling machinery, Charlie joined Wallace and Tiernan in 1924, confining his early efforts to flour milling. After serving as W. & T. District Manager in Jacksonville, Fla., and then in export work in the head office, Eastwood was made advertising manager. From this position he was temporarily on leave, doing some work for W. & T. in California, when he was stricken with a heart attack a few weeks ago.

Charlie Eastwood was well known to many readers of *Water Works and Sewerage* and was as well liked as he was well known. His passing leaves another gap in the ranks of America's finest of the "Ambassadors of Commerce" in the water and sewage field.

INDUSTRIAL WASTES AND FISH LIFE*

By

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The Author

THE theme of this Conference on Utilization of Trade Wastes, is particularly pleasing to those concerned with fisheries. Indeed, utilization of such wastes presents a happy solution to many serious and often annoying problems which perplex both the industrialist and the aquatic biologist. The sincere conservationist believes that the public waters are natural assets to be used and enjoyed by all, and that those charged with the legal problems arising from the use of public waters must seek, as has been pointed out in this conference and elsewhere, the greatest good for the greatest number. Therefore the evaluation of fisheries which include not only sport fishing and recreation, but commercial fishing and food production as well, must be made with due consideration of all the many interests involved, and is not the province of this presentation.

Most aquatic organisms including fish are adjusted to a complex set of environmental conditions and tolerate only limited deviations from an expected normal, whether these changes be produced by municipal wastes, industrial effluents and other man-made pollutants, or by geyser waters, volcanic ash, forest fires, uncontrolled erosion and other natural causes.

The Fish Dies Only Once

The aquatic biologist is faced therefore with much the same general sort of problems as the plant superintendent, if the fish is to be maintained and operated at a profit, in this severely defined environment to which the fish is restricted by very specific physical and chemical factors. First there must be ample and suitable raw material, (in the case of the fish, food and oxygen) supplied continuously; next, the several physiological systems of the fish must function in optimal fashion in spite of the fact that most of these systems in the fish are equipped with machinery which the modern engineer would remove speedily as out-of-date and of low efficiency, and for which repairs are unobtainable, that is, a single trivial breakdown will result in a complete shut-down of a fish's operations and a single shut-down is final, as a fish dies only once; then there are the problems of replacement, for when the old plant is worn out it must be completely replaced by a new plant; that is by a new fish built unfortunately according to the same blue prints and with the same limitations as its predecessors.

The Water Quality Unit of the Fish and Wildlife Service is essentially an investigational and research organization charged with fact finding concerning fishes and their limitations. The writer wishes to present certain of these limitations which render fish particularly vulnerable to trade wastes. These characteristics of fishes therefore make possible a classification of trade wastes based on the physiological action rather than the sources of the waste, and point out those groups of substances in trade wastes which should be utilized or otherwise eliminated if fishes are to be accorded successful maintenance conditions.

Classifying Trade Wastes from The Fish's Point of View

The components of trade wastes and municipal effluents hazardous to fish and other aquatic life can be grouped conveniently into five series, four of which contrary to popular belief are composed of substances which may not be toxic or poisonous in themselves but are lethal because of the intolerable conditions which they produce. Many wastes contain more than one dangerous component and frequently one material may produce several detrimental conditions, so the grouping necessarily has some overlapping. Grossly, however, from the standpoint of the fish there are at least five major categories, namely:

(1) Suspensoids which blanket or cover the stream bottom and submerged objects in the stream,

(2) Substances having an oxygen demand or oxygen consuming power,

(3) Compounds altering the relative acidity or alkalinity of the water (pH),

(4) Materials increasing or changing the salinity of the water, and

(5) Specifically toxic substances.

Regardless of origin any substance capable of producing any of the effects just enumerated becomes a potential pollution hazard to fish and other aquatic life when introduced into the public waters, for the gamuts of adjustment by fish to such changes are small indeed.

Bottom Blankets

Anything which can accumulate on the bottom of the streams, lakes, or impoundments is potentially a serious pollution hazard. This category includes wood fiber, sawdust, paper pulp, rock powder, mine slimes, mud from various washing operations, oil wastes, tars, unreduced sewage and many other often inert materials. These substances which are not readily destroyed or carried away by stream movement and which are removed slowly at best by oxidation or bacterial action, blanket the bottom and smother out the bottom biota so important for fish food.

The floor of the stream or lake becomes therefor an aquatic desert with nothing to support the higher forms of life. The amount of material required to blanket the bottom to a stage where it can no longer support the needed bottom fauna is often surprisingly small. Only last summer the writer found a bottom coating of non-toxic rock powder less than a quarter of an inch in thickness to have completely destroyed all fish food in a fine Montana trout stream. Similarly some of you may have noted here in Indiana how little of the fine limestone powder from the rock-sawing operations is required to kill out the bottom fauna in an otherwise unpolluted stream, and how insidious the advance of this form of pollution can be.

Often other substances are either laked down by the settling sediment or become entangled in the bottom mat if the waste material be fibrous, and create additional hazards through oxygen demand, bacterial action or specific toxicity. Any appreciable quantity of suspended or insoluble matter in any

*A paper read by the author at the First Industrial Waste Utilization Conference, held at Purdue University, Lafayette, Ind.

effluent is viewed therefore with concern by the aquatic biologist.

Fortunately there has been much improvement in removing suspended and insoluble substances from industrial effluents during the past few years, chiefly because these materials are now being utilized. The deposits of wood fiber, often 3 to 6 feet deep which formerly could be found in many eastern streams are disappearing for the companies producing wood pulp have found the pulp too valuable to waste. Several western and Canadian mining companies are impounding their mine slimes successfully and are finding that this operation not only pays good returns, in better streams, but in dollars to the company through the reclamation of low grade or otherwise unused ores which were lost formerly. A southern foundry company is now settling-out tons of calcium hydroxide residue from its acetylene generators and using this reclaimed powder in place of lime and limestone in some of its operations. A wood-processing concern which formerly had acres of unsatisfactory settling basins from which enormous volumes of waste rich in a very fine wood residue was lost annually to the serious damage of a nearby river system, now recirculates this fluid, reclaims almost all of the wood material and other valuable substances at a profit and has no overflow from its settling ponds.

Oxygen Demanding Substances

The second group, those substances creating oxygen demand, is perhaps the one most frequently mentioned by sanitary engineers and others interested in waste disposal after it enters the stream because biochemical oxygen demand (B.O.D.) and population equivalents are two very valuable units of measurement if the destruction of the waste by oxidization be the objective. However, these values are by no means as significant to the aquatic biologist as to the disposal engineer. Erroneous conclusions are often made therefore by attempting to evaluate the biological effects of certain wastes in these terms. Both the method of evaluation and the final objective of the engineer and the biologist are quite different in the dissolved oxygen complex as well as in several other pollution problems. The explanation of these differences is so important to the understanding of the biologist's interpretations that it seems well to digress for such an explanation.

Experimental work has demonstrated repeatedly that fish readily survive and are not injured by relatively high concentrations of untreated sewage, certain beet sugar effluents, some wood extractives and many other components of wastes currently discharged into our streams and having high B.O.D. if first, no specifically toxic substance be present and if the water containing these wastes be aerated continuously to maintain the dissolved oxygen level at 5 ppm. or above. Termination of the aeration, however, speedily results in death of the fish as soon as the dissolved oxygen drops to the critical level. It is not therefore the B.O.D. of the substances in the water that matters but the actual dissolved oxygen level maintained.

Average Data Not the Criteria

Again, many stream pollution studies have been based on averages, and in such studies various agencies have installed at much expense and effort rotating fractional samplers or other devices to provide pooled, and therefore averaged, collective samples over a period of hours or days. Although such samplings provide the plant engineer with valuable quantitative data concerning his total losses, and these figures may have important applications to some stream problems, averages of turbidity, dissolved oxygen, relative acidity, salinity and of the per cents of various toxic substances present should not be used in determining the pollution hazards to aquatic life.

The average may show ample dissolved oxygen or non-lethal acidity over a period of hours or days, but a slight fall in dissolved oxygen to the critical level or a slight rise in acidity for only a few minutes can kill out the entire fish fauna for several miles below the effluent flume, although these slight changes in dissolved oxygen or acidity or any of the other hazardous characteristics are completely obliterated on the average sheet. The biologist therefore is interested in the worst that can happen even though such conditions be maintained for only a short time, for fish and other aquatic organisms are extremely sensitive to slight changes in environmental conditions beyond the narrow limits of variation which they can tolerate, and again one must repeat, "a fish dies only once," and it may take years to re-establish the fauna which can be killed in a few minutes.

Effluents having high oxygen demand are particularly hazardous to fish because the waters receiving such wastes are usually overloaded beyond the natural aeration possibilities of the stream or lake.

The average fresh-water stream or lake in midsummer when conditions are poorest for the retention of dissolved oxygen carries 5-6 parts per million of dissolved oxygen if conditions are favorable, but much less dissolved oxygen if the water temperature rises, or if stream flow is reduced or if any one of several other things happen. Consequently fresh-water fish which require 5 ppm. of dissolved oxygen for favorable growth, maintenance and reproduction, and which are distinctly handicapped if the dissolved oxygen falls to 3 ppm., often find it difficult or impossible to obtain adequate oxygen for life in streams polluted with substances having a marked oxygen demand. With the limited amount of oxygen available in water under even favorable conditions, very slight increases in the oxygen demand of materials carried by the stream water may reduce the dissolved oxygen readily to a critical level for fishes.

Oxygen Requirements for Fish

In this connection it may be pointed out that fishes like human beings and many other animals can continue to live for a time, that is can eke out an unsatisfactory existence, under conditions which although unfavorable are sublethal at the time. So, although it is well established that fresh-water fishes require about 5 ppm. of dissolved oxygen in the water if other conditions be satisfactory, for successful growth maintenance and reproduction, it is frequently countered in discussions of pollution hazards that fish were found living in the polluted water and that the dissolved oxygen was only 3 or even 2.5 ppm.

It is true that fresh-water fishes can survive for a time in water carrying less than the desired 5 ppm. of dissolved oxygen, but physiological and biochemical studies of such fish show that they are not prospering, that the formation of reproductive cells is reduced or stopped and that the fish's susceptibility to acids, metallic poisons and many other hazards has been greatly increased. This reduction of dissolved oxygen to an unfavorable although not immediately lethal level is one of the usually unnoticed effects of substances having a high oxygen demand, and is responsible for the general failure of fisheries in many streams so polluted.

Chief among the wastes having high oxygen demand are sewage, cannery wastes, packing plant wastes and certain chemical effluents, carrying either sulfur compounds or compounds of various metals in which the metal is in the low valence phase.

Various processes have been patented covering the utilization of wastes rich in these substances having a high oxygen demand. Several of these procedures make use of the dried waste as fuel to evaporate more effluent to the dry stage. Reports show that these self-firing incinerator processes pay their way and more. Numerous methods for the reclamation of the valuable components of municipal sewage and garbage are well known but this is still a fruitful field for both chemical and biological research.

Hydrogen Ion Concentration Or pH

The hydrogen ion concentration of the effluent is also of major importance to the aquatic biologist, because fish and the common aquatic organisms are most successful in waters having a relative acidity between pH 6.5 and pH 8.4. Wastes more acid than pH 5.0, or more alkaline than pH 9.0 range definitely from detrimental to lethal, as fishes show disturbances of the cardiovascular and respiratory systems if forced to live in water more acid than pH 5.0, or more alkaline than pH 9.0 for even a few days.

One of the very vulnerable parts of a fish's body is the gill complex which functions as a respiratory and excretory unit, and also regulates the flow of blood to the major organs of the body. Acid water impairs the oxygen absorbing power of the gills, renders certain excretory cells useless and stops the flow of blood through the gills and thence to the vital organs by producing congested areas and stasis in the terminal portions of the gill filaments.

Alkaline waters dissolve away the protective mucous from the gill filaments, causing hemorrhages and also stasis of the circulation. An increase in acidity to pH 4.0 if produced by the common heavy acids is usually fatal to fresh-water fishes in a few minutes and alkalinity of pH 9.8 or greater if the result of caustic alkalis or even alkaline carbonates or lime speedily causes fatal hemorrhages.

Experimental work recently completed in our laboratories at Columbia, Missouri, and Spearfish, S. D., has shown that changes of acidity or alkalinity much less than these just cited can be fatal to various warm water fishes and trout in the course of a few hours if the temperature of the water be raised slightly or if the dissolved oxygen content of the water be slightly lowered. Seemingly trivial changes in acidity or alkalinity therefore throw the temperature and oxygen tolerance off balance and the fish readily succumbs to a combination of conditions any one of which could have been weathered alone.

Buffering Capacity of Streams

The relative acidity and alkalinity hazards of effluents are often surprising to plant operators who first fail to recognize that fresh-water streams in general are very poorly buffered and because the chemist thinking in terms of tank cars of acid does not realize often how little free acid is required to bring the average river water to a dangerous acidity. The writer was assured by the director of a large chemical plant quite recently that the loss of free acid by his concern which was using large quantities of nitric and sulfuric acid amounted to less than 0.01 per cent. Yet the effluent from that plant had raised the acidity in the nearby stream receiving the wastes from this chemical works to pH 4.0 for some six miles downstream, completely erradicating all aquatic life in that sector.

The free acids in industrial wastes should be neutralized as the present methods of reclamation do not seem to pay. Perhaps the acid effluents could be used as such for cleaning rock, ore or metal, and some service obtained from the contained acid. Satisfactory neutralization basins are in operation at many chemical plants, but neutralization requires much attention. Merely dumping in limestone and forgetting the waste will not suffice.

Salts and Brines

Salts and the specific conductance of the water aside from any toxic action of the salts themselves must be considered particularly in fresh-water streams as most fresh-water animals respond unfavorably to sudden changes in osmotic pressure. The largest source of such pollution is oil well waters and the oil well operators are faced with the disposal of huge quantities of strongly salt water which because of the contained magnesium and other minerals makes profitable utilization of the brine impracticable at present.

Various chemical works have produced osmotic catastrophes from time to time by liberating large volumes of brine or other salt solutions of strong concentration into public streams. The introduction of quantities of brine by a chemical works in the east a few years ago killed everything in the stream for miles below the plant as the density current of brine rolled along the floor of the river. This was an accident, but accidents are often more dangerous to aquatic life than continuous fluming of wastes into a stream as there is no opportunity for adjustment to the accidental and sudden inundation with a strong waste.

This brings up a contact between industry and fisheries for which the lethal density current of brine provides the example, but which should be considered by all plant operators and by municipal sewage disposal units as well. Throughout this conference the human element has been stressed frequently and the devices to check up the operations of the careless worker described. The frailties and limitations of apparatus and equipment have also called for deserving discussion.

The pump should work but sometimes it fails, the evaporator is clog-proof but still it stops up on occasion, and the human operator is attentive but sometimes he forgets. The aquatic biologist sees in all of these limitations to proper plant maintenance potential pollution hazards of great magnitude. If the sewage works basins become clogged the operator merely by-passes the untreated wastes until he can make his adjustments and turn the sewage back into his plant. Meanwhile aquatic life may have been killed for miles downstream and restoration may require several years.

Again if the chemical plant which lost its brine had had a trench or a basin around its brine tank, much of the brine could have been saved for use and the catastrophe from which that river has not recovered after four years could have been averted. Alternate safety disposal basins and other safety provisions could do much to prevent these stream catastrophes as well as conserve material for the plant, for accidents will surely happen.

Specific Toxic Pollutants and Aquatic Deserts

If the fish and the associated aquatic biota are surrounded by water carrying ample dissolved oxygen, of suitable pH and proper specific conductance, over a clean bottom supporting ample food organisms, there still remain the problems of specifically toxic pollutants. These are often effective in very high dilution, are frequently cumulative in action and may not strike the fish at all but may destroy some organisms on which the fish is indirectly dependent.

A striking example of this has recently come to the writer's attention but because of war restrictions it is not permitted to mention the specific concern nor stream here. This plant is engaged in the manufacture of a cellulose product and has taken the commonly accepted measures in preparing its effluent for admission into the stream, namely settling basins and neutralizing basins. The effluent although strongly acid was speedily neutralized by the limestone on the floor of the stream bed so that less than a mile below the outlet the acidity was reduced to pH 7.4. There was no oxygen demand, the stream was well aerated and the bottom was not coated with deposit.

For 40 miles below the plant, however, within a year after the effluent was first admitted all fish disappeared from what had been a fine fishing stream. Also all fish food organisms died out, although fish will live in captivity in the water from this river taken any place in the forty-mile sector which is now practically devoid of animal life. This effluent in all reasonable dilutions is tolerated readily by fish and most aquatic organisms.

After much study of this problem we have found a salt of one of the common metals to be present in this effluent in quantities larger than are expected in normal streams, but even so in a concentration far below the toxic level for most aquatic life. This common metal, however, had killed certain of the lower forms of life on which the food chains for this stream are built, so that successively other forms died out from starvation and those like fish which could escape moved away. The reclamation of the small quantities of this metallic salt will easily rectify this situation although it may be difficult to remove the few milligrams per liter of the obnoxious elements.

Research and Cooperation the Hope of the Future

So the field for cooperation in both the practical and research studies of the action of the small quantities of the specifically toxic substances which may cause serious difficulties after the more valuable components of the effluent have been reclaimed is large. New industries are bringing out new

processes and with these come new wastes to be reclaimed or otherwise disposed of. For example this war has produced new demands for explosives and some chemical works are producing huge quantities of a bright orange-red fluid carrying certain asymmetrical nitro-compounds which when removed from the valuable explosives forms a brilliant dye. Some of our streams have been colored red for miles by this waste which fortunately is not very toxic alone. But the alluring problem is the compound itself, which is an elaborate organic molecule that ought to serve as the basis for further useful synthetic chemistry, and again our streams would run colorless instead of red.

Again the reclamation of the sugars, lignins, resins, and other products of the wood digester which now cause the aquatic biologist much concern as they break down into so many insidious toxic compounds, could surely pay its way if the utilization could be made.

During the past summer the writer has visited 27 states on pollution problems. It is a pleasure to report that industry, as never before, is either utilizing its wastes or making sincere efforts to rectify its objectional effluents. Exceptions to this statement are happily few. If the cooperative research of the industrial chemist and the aquatic biologist be continued as it is now progressing our pollution problems will be solved with beneficial results for all.

How to Maintain Oil Circuit Breakers

By N. P. WILSON
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To prevent costly failures and delays in operation, it is important that the starting breaker functions properly when an emergency arises. To accomplish this reliability, it is necessary that the breaker receive periodical thorough inspection and maintenance. Motor starting, oil circuit breakers are designed for general starting service. When properly applied they protect the motor from overloads, short-circuits and guard against the sudden application of full voltage to the motor after it has come to rest.

The frequency of inspection and maintenance depends upon the severity of the duty which the breaker must perform and the condition of operation. Usually a light monthly inspection with a thorough inspection and maintenance semi-annually should be satisfactory. However, in some cases breakers operating under very active and severe service may require more frequent attention. Other breakers that operate infrequently and under less severe duty will naturally require less attention. The frequency of inspection will be largely determined by experience.

Ten points to check for proper maintenance:

1. Before making any adjustment to an oil circuit breaker, make sure that all lines leading to it are electrically dead.

2. Be sure the breaker frame is grounded.

3. Do not operate the breaker excessively by the electrical operating mechanism when the oil tank is removed.

4. Examine all contacts frequently, especially after severe short circuits, to see that contacts are properly aligned. Dress or replace contacts that are burned.

5. After making adjustments, test the breaker by hand to make sure that it operates smoothly and correctly.

6. Inspect the oil regularly and after severe short-circuits. If it shows signs of moisture, carbonization or dirt, filter and retest it before replacing it in service. See that the oil level in the tanks is maintained at the proper height.

7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods and terminal bushings at least once a year.

8. Thoroughly inspect all bolts and nuts; tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

9. Dielectric tests of the oil should be made every three months to show if it is reasonably good for circuit breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. If testing for indication of water, take the sample from the bottom of the tank. For indication of carbon and after a heavy short-circuit, take the sample from the surface of the oil.

10. Arrange for regular inspection to see that the circuit breaker is in adjustment, the oil of good quality, and the complete breaker functions as required.

How to Find the Open Area of Wire Screen or Wire Cloth

The rule or formula that is generally used for finding the open area of wire screen has always struck this writer as being cumbersome because it goes at the problem "backwards." It gives the closed area, and then we are told to subtract that area from 1. The answer will be correct, of course, but the method is clumsy. The following rule gives the open area directly.

A—Multiply the number of wires in the warp per inch by the diameter of the warp wires in inches and subtract the product from 1. Call the answer "A."

B—Multiply the number of wires in the shoot per inch by the diameter of the shoot wires in inches and subtract the product from 1. Call the answer "B."

C—Multiply "A" by "B" and the product is the open area.

For example: What is the open area of a wire screen having 6 warp wires per inch and 6 shoot wires per inch, the diameter of all wires being 0.025 in.?

Substituting in the above rule we have this:

A—6×0.025 equals 0.15. Subtracting 0.15 from 1 we have 0.85.

B—Since the shoot and warp wires are the same we get the same result from "B" as for "A," namely 0.85.

C—0.85×0.85 equals 0.7225.

The "answer," therefore, is 0.7225, which means that the open area of this particular wire screen is 72¼ per cent.

For those who prefer formulas to rules the formula is:

$$\text{Open area} = (1 - ND)\ (1 - nd)$$

where

N = number of wires in the warp per inch;
n = number of wires in the shoot per inch;
D = diameter of wires in the warp, (inches);
d = diameter of wires in the shoot (inches).

Contributed by W. F. Schaphorst, M.E., Newark, N. J.

ESTIMATING VARIATIONS IN DOMESTIC SEWAGE FLOWS

By H. M. GIFFT
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The Author

FLUCTUATIONS in sewage flows have an effect on the operation of all parts of a sewerage system and treatment plant. It has always been common practice to consider these variations when designing sewers but the methods of estimating these fluctuations have been anything but uniform.

For example, from a questionnaire answered by 67 consulting, municipal, and state engineers in the United States and Canada, Malcolm[1] found that 46 used a factor of 2 *or less* when estimating the maximum rate of flow in terms of the average for sewer design. On the other hand, the New York State Dep't of Health requires that laterals and sub-mains have a capacity not less than 4.0 and mains or trunk sewers a capacity not less than 2.5 times the average flow. Such a discrepancy would indicate that many sewers have been inadequately designed. While this may be true, possibly a compensating factor is that 42 of the engineers indicated that they designed sewers to run only half full at maximum flows.

Often these fluctuations have been disregarded in treatment plant design, particularly for the smaller installations, although the greatest fluctuation in flow usually occurs in the smaller plants. Some engineers have, of course, considered the effects of these variations on the operation of the units of the plant, either as to maximum and minimum instantaneous flows or for maximum or minimum averages over some part of the day. For example, in the design of Army camps the U. S. Engineers specified the average sixteen-hour flow as 125 per cent, the maximum four-hour flow as 175 per cent, and the minimum four-hour flow, as 40 per cent of the average twenty-four-hour flow.[2]

For any particular day the sewage is ordinarily of greatest strength during the periods of g r e a t e s t discharge; therefore considerations of the peak flows are logical. Because of the possibilities of septicity in settling tanks, and minimum dosing rate requirements on high-rate filters, minimum flows should also be considered.

Maximum and Minimum Flows

In past years, relatively meager information has been available to the designer regarding minimum flows. Even information regarding maximum flows has been limited and the various sources of information sometimes in complete disagreement. Often the literature has been careful to include a great many figures on actual sewage flows at various specific places, but pertinent information such as contributing population, date of record, type of area, etc., have been omitted.

That the magnitude of these fluctuations is influenced by the number of persons contributing has long been recognized. While agreement has been reached that the smallest areas produce the greatest variations in flow, there has been some disagreement as to method of considering the influencing factors when estimating these fluctuations.

For example, Harmon[3] found the maximum flow to be

$$\left(1 + \frac{14}{4 + \sqrt{P}}\right) \times \text{avg. flow}$$

where P is the contributing population in thousands. According to Babbitt[4] this coefficient should be $5/P^{1/6}$. The recent Corps of Engineers specifications called for individual coefficients depending on the contributing populations. Metcalf and Eddy[5] present a chart showing peak discharges in mgd. in terms of the average discharge. Johnson[6] presented information of both maximum and minimum rates of discharge based on actual sewer gagings covering flows from 0.1 to 400 cfs. These data also give actual discharges as a function of the average discharges.

Although per capita flow might have an effect on the variations, the diverse habits of the people and the size of the contributing area undoubtedly are of much greater importance. Since the contributing population is proportional to the area served, and since variation in both population and size of area affect the magnitude of the fluctuations in the same manner, the method of expressing the fluctuations as used by Harmon, Babbitt, and the Corps of Engineers should be satisfactory.

Correlating Methods

As a means of correlating the above methods, the data from Metcalf & Eddy and from Johnson were coverged to ratios of extreme to average flow for different population by assuming per capita flows varying from 60 gpcd. for population of 1000, gradually increasing to 100 gpcd. for population of 100,000. These curves, together with the curves of Harmon, Babbitt, and the Corps of Engineers were plotted in Fig. 1.

It was noticed when examining the plottings of Johnson[6] that, often *both* the minimum and maximum flows for a certain station appeared either too high or too low with respect to the general pattern of the plottings of all the points. Such plottings would suggest that either the estimated average flow for the station was inaccurate or *both* the maximum and minimum gagings were in error in the *same* direction. Considering the difficulties involved in estimating an average flow from recordings of a variable flow, the former possibility seemed the more likely. Lines were drawn through the centers of the two groups of plotting, then the two gagings for a single station which both deviated from this line in the *same* direction were moved horizontally until the deviations were approximately the same in *opposite* directions. The maximum and minimum lines were then drawn and finally converted to coefficients of average flows and plotted in Fig. 1.

Giving due consideration to the various plottings, particularly the gagings by Johnson, a maximum curve having the equation of $C = \frac{5}{P^{1/6}}$, and a minimum curve having the equation of $C = 0.2P^{1/6}$, are proposed.

Normal Fluctuation of Flows

These variations in extreme flows, while of possible interest in connection with treatment processes are of particular importance insofar as hydraulic design is concerned. Of greater interest from the treatment standpoint are the fluctuations in flow which occur more often and under usual operating circumstances.

Points could be plotted representing maximum and minimum averages for various portions of a day, as well as the average flows for various periods during normal days. All of these data

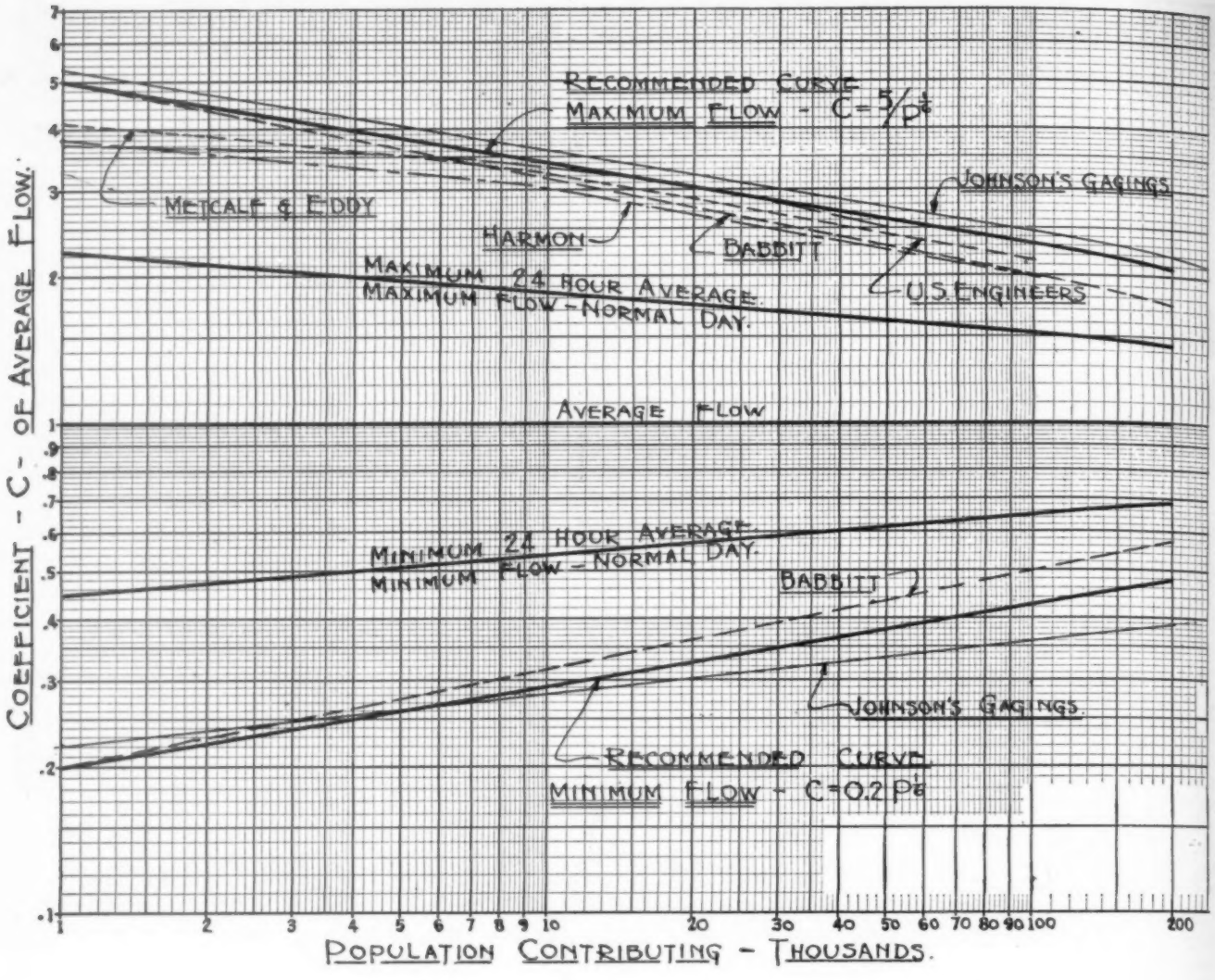


Fig. 1. Relation Between Extreme Domestic Sewage Flows and Contributing Population

would, of course, fall within the maximum and minimum instantaneous flows. Such data are very limited, although figures are available on maximum and minimum 24-hour averages and typical flow charts for various days. Points representing extreme 24-hour averages and extremes for typical days were plotted as coefficients of the average flow.

From the data considered, the general pattern for both groupings appeared to be about the same, indicating that the normal expectancy for extreme 24-hour averages might be comparable to the extreme flows during a normal day. Although additional data might indicate otherwise, the inequality could not be great.

Nomograph for Flow Variations

Considering the inaccuracies of the data themselves, the above assumption was used in the construction of the nomographic chart in Fig. 2. The use of the chart is very simple. A straight edge is merely lined between the *average* gpcd. and the contributing population, then the desired information is read directly on the appropriate scale.

For example, with an average flow of 100 gpcd. and a contributing population of 10,000, the following rates of flow, in mgd., might be expected:

	Normal Day	Minimum Day	Maximum Day
Minimum Rate of Flow.....	0.55	0.3	
Minimum 12-hour Average ..	0.75	0.4	
24-Hour Average	1.0	0.55	1.9
Maximum 12-hour Average..	1.4		2.5
Maximum Rate of Flow.....	1.9		3.5

Obviously the actual flows from various communities will not be exactly as represented by this chart. Where adequate records of fluctuation in flows are available they should by all means be used. Very seldom, however, are specific data available regarding the extreme fluctuations and often even the information on normal fluctuations is meager. Not only should the chart be of value to supplement inadequate data for sewerage design but might, because of the simplicity of application, stimulate an increased consideration of variable flows for treatment plant design.

References

[1]Malcolm, W. L., Sewer Design Practices, Water Works and Sewerage, 91, 227 (1944).

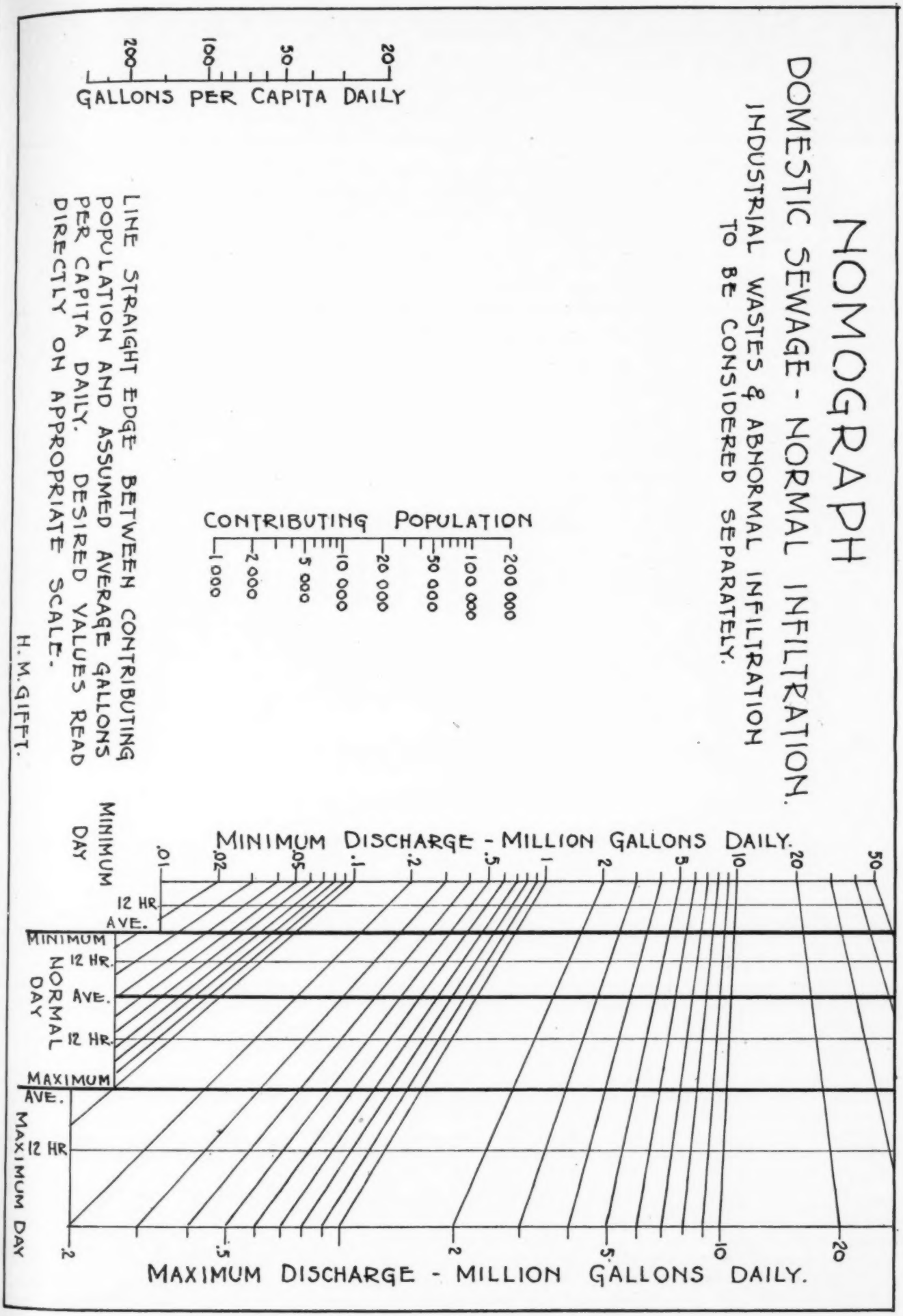
[2]Stanley, W. E., Designing Sewage Treatment Plants for Army Camps. Sewage Works Engineering, 13, 240. May, 1942.

[3]Harmon, W. G., Forecasting Sewage Discharge at Toledo Under Dry-Weather Conditions, Engineering News-Record, 80, 1233 (1918).

[4]Babbitt, H. E., Sewerage and Sewage Disposal. John Wiley & Sons (1932).

[5]Metcalf, L., and Eddy, H. P., American Sewerage Practice, Vol. I., Design of Sewers, McGraw-Hill. (1935).

[6]Johnson, C. F., Relation Between Average and Extreme Sewage Flow Rates, Engineering News-Record, 129, 500 (1942).


NOMOGRAPH
DOMESTIC SEWAGE - NORMAL INFILTRATION.
INDUSTRIAL WASTES & ABNORMAL INFILTRATION TO BE CONSIDERED SEPARATELY.
200
100
50
20
GALLONS PER CAPITA DAILY
CONTRIBUTING POPULATION
1 000
2 000
5 000
10 000
20 000
50 000
100 000
200 000
LINE STRAIGHT EDGE BETWEEN CONTRIBUTING POPULATION AND ASSUMED AVERAGE GALLONS PER CAPITA DAILY. DESIRED VALUES READ DIRECTLY ON APPROPRIATE SCALE.
H. M. GIFFT.
MINIMUM DISCHARGE - MILLION GALLONS DAILY.
.01
.02
.05
.1
.2
.5
1
2
5
10
20
50
MINIMUM DAY
12 HR. AVE.
NORMAL DAY
MINIMUM 12 HR. AVE.
12 HR.
MAXIMUM AVE.
MAXIMUM DAY
12 HR.
.2
.5
2
5
10
20
MAXIMUM DISCHARGE - MILLION GALLONS DAILY.

STRAIGHT FROM OUR READERS

What They Tell Us and What They Ask About—

PACKING

From personal interviews, Water Works and Sewerage is learning the thoughts, likes, dislikes, problems and questions of its readers. Because we believe other readers will be interested in the problems, questions and comments of various superintendents, engineers, chemists, operators, and consultants in the field of water purification and sewage disposal, we shall publish these comments whenever space permits.

Each feature page will consist of quoted statements taken from various interview reports. In several cases the particular topic may require more than one issue for the material on hand.

If you have not yet been interviewed, and have any thoughts on these subjects, we shall be pleased to receive your comments by mail for publication in future issues.

Sludge Pump Packing

"We have three — — pumps and two —. One minor, though very annoying, thing about the — is that they overflow and mess up the floor of the plant. We had to build a cement trough around them to catch this overflow. The — overflows a little but that is easily taken care of by installing a small pipe."

* * *

"We now use — packing in our pumps. We used — packing for a while but that wore out too quickly. We find that if you keep your packing down tight, you won't get any overflow from the pistons. The — packing in this pump was put in about a year ago and there's no leak yet. I keep a small pool of oil on top of the packing and that helps."

* * *

"We use both graphite and — packing here and find them both satisfactory. I'd like to see somebody find a better material for the discs in the control valves. The rubber and canvas ones we have now crack and it's a job replacing them."

* * *

"Our sludge pumps did overflow at the piston. In fact, we had an angle iron trough around the pump with a faucet to take off the mess into a pail. It was terrible, especially in the summertime with the flies all around it. We cured that, however. We called in the — — packing company and their representative measured the pump and sent us the correct size for the piston. It works swell. Not a drop comes over. As an extra precaution I keep some oil on top of the packing."

* * *

"We did have trouble with our sludge pumps overflowing at the piston and messing up the place, but it doesn't happen since I got — — packing. I found out about it when I called the Association and asked them to recommend a good serviceable packing. The packing in the pump now has been in for two years. It costs less and has saved us a lot of operating headaches."

* * *

"We did have a problem with sludge overflowing from the piston on the sludge pumps. It not only messed up the floor but went into the cylinder and got in the oil. The pump was equipped with an angle iron to catch most of it, but even that was messy and we had to keep the building closed in the summertime to keep the flies off. We were trying out — — packing at the time we decided to get rid of the plunger pumps. The — — salesman who called on us persuaded us to try it and it worked fine for the short time we had it in."

* * *

"Our plunger sludge pump does leak at the piston and overflow. I've installed a channel iron trough with a pipe outlet around the concrete base to catch it, though, and we empty it into a pail and dispose of it. I haven't heard of any packing that would eliminate that. It isn't bad, except in the summer. I think it should leak a little, anyway. If your packing is tight it causes too much heat and friction, your packing wears out quickly, and you get additional wear on the piston."

* * *

". . . We were looking for a packing for the plunger sludge pumps. They were a mess. They were leaking so much that sometimes there would be three or four inches of mush all over the floor. You couldn't go near the place in the summertime with all the mosquitoes congregating there. We tried three or four different packings but got nowhere. Finally we tried — —. A former maintenance man of ours who was working at Camp Kilmer heard about it and suggested we try it. That stuff works like a charm. The present packing has been in over a year and that pump is so clean you could eat off it."

Centrifugal Pump Packing

"We use rawhide packing in our pumps and find that it lasts longer than the asbestos type, although I do notice some additional wear in the sleeves around the shaft of the pumps."

* * *

"We have a low lift pumping station equipped with — — centrifugal pumps. We did have some trouble with packing until we switched to — —. It's a marine packing and stands up very well. I found out about it when the salesman dropped in one day and asked me to try it. Before I put it in, however, I visited some other plants around here that are using it and asked the operators if the stuff was any good. I got good reports all around. I haven't experienced any scoring of shafts with it. If you ask me, I think you'll score a shaft with any kind of packing if you have the gland pulled down too far."

* * *

"We did have some trouble with packing but have finally gotten around to the solution of using — — packing on the hot water pumps and rawhide packing on the cold water pumps. We tried the — — on the centrifugals but it scored the shafts, so we turned to the rawhide, which, frankly, I'd like to find a substitute for, because it's too expensive."

* * *

"We've been having trouble getting a packing that would stand up in our centrifugal pumps. The manufacturer advised the use of rawhide. It's a good soft packing and prevents unnecessary wear on parts, but it's too expensive to use because it doesn't last long. It gets soapy and washes out. We were using a graphite packing that was fine until a short time ago. Now they don't put a good grade of graphite in the

packing so we've had to give it up and look for something else. We're about to experiment with a — — packing that the salesman just persuaded me to try."

* * *

Valve Packing

"It seems that the manufacturers insist on equipping pumps and valves with rawhide packing. We haven't found that it gives good service here. It doesn't stand up and it takes two men to open or close a big valve because the packing is so stiff. However, the manufacturers seem to be sold on the rawhide and won't hear of anything else. The packing salesmen began hounding us soon after the plant opened and we tried four or five different brands. We finally hit on a graphite impregnated asbestos that works swell. As a matter of fact, one man can now open one of those big valves where it took two before, and that's a big factor in these days of manpower shortage."

* * *

"We overhaul our valves about every two years and replace the packing and worn parts. We found the twisted flax packing the best, though a little more expensive. It has a close texture and is impregnated with a special grease that works very well. We use —, too, in certain applications."

* * *

"We've tried all kinds of packing in our pumps. We now use a combination graphite and flax packing that's put out by —. It does a good job. We go over the pumps once a year and replace the packing then. We never have packing trouble between times. The only place we are having packing trouble is in the — hydraulic valves. They're always leaking like that. We even have a packing manufacturer right here in town and he's tried everything he can think of, but so far we haven't had anything that will work. The shaft scores whatever we put in. If you come across somebody who has a packing that will stand up in those hydraulic valves, I'd like to know what he is using."

"Gus" Brenneke Joins Venezuela's New National Institute of Public Works

A. M. Brenneke, former City Eng'r and Supt. of Water at Dennison, Texas, and lately Eng'r in Charge of Salt Water Pollution Investigations for the Texas State Dep't of Health, has accepted a position with the recently organized Federal Dep't of Sanitary Engineering of Venezuela—the Instituto Nacional de Obras Sanitarias.

A. M. Brenneke

Mr. Brenneke ("Gus" to his many friends in Texas and the Southwest generally) will assist in the modernization, rehabilitation, enlargement and operation of the many existing water supply systems of Venezuela. Likewise, in the design and construction of the numerous new systems proposed for the many communities still lacking public water supply and effective sanitation.

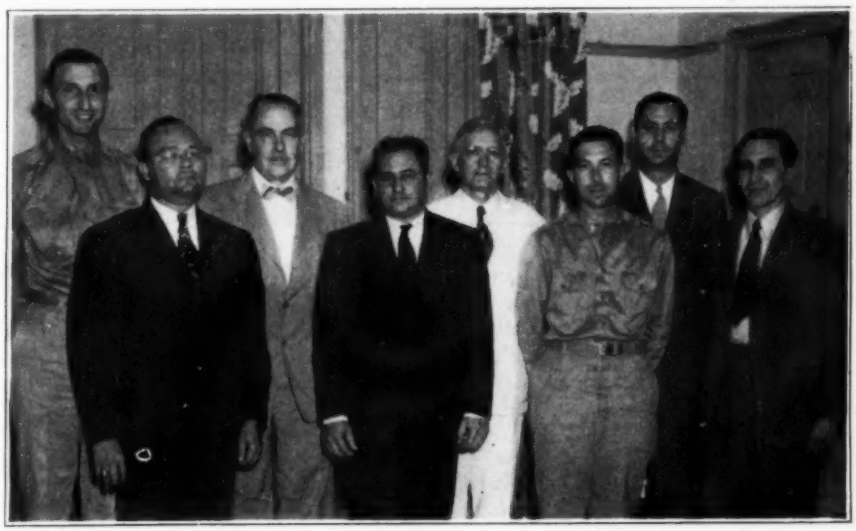
All public water supply and sewerage systems of Venezuela have recently been placed under the jurisdiction of this new Federal Department which is served by Dr. George C. Bunker as Consulting Engineer. Mr. Brenneke's new address is—% Instituto Nacional de Obras Sanitarias, Caracas, Venezuela.

Caribbean Water Works Association Formed

On February 15, 1945, a new sanitary engineering organization known as the Caribbean Water Works Association was formed in San Juan, Puerto Rico.

Dedicated to the advancement of knowledge of the design, construction, operation, and management of water works, with particular reference to the tropics of the Western Hemisphere, this association will be made up of members from all the islands in the entire Caribbean Area, including Haiti, Santo Domingo, and the British, French, and Dutch possessions in the West Indies.

The story of the formation of this association came from E. J. Herringer, Sanitary Engineer, District Engineer of District No. 6, U. S. Public Health Service, San Juan, Puerto Rico. The accompanying photograph was also furnished by Mr. Herringer.



New Caribbean Water Works Assn's "Steering Committee"

Rear row, left to right: Sr. Assistant Sanitary Engineer (R), Vernon B. Hammer; Consulting Engineer Malcolm Pirnie; Consulting Engineer R. A. Gonzalez (Mr. Pirnie's representative in Puerto Rico); Sanitary Engineer G. Diago, Bureau of Sanitary Engineering, Insular Health Department.

Front row, left to right: Mr. A. Hernandez, Hydraulic Engineer, Insular Aqueduct Service; Mr. F. Ramirez, Professor of Chemistry, College of Agriculture and Mechanic Arts, and water plant operator at Mayaguez, P. R.; Sanitary Engineer E. J. Herringer, and Mr. M. Seoane, Mayor of the City of Caguas (outstanding for his interest in good water works practice.)

The Editor's Comments

Who Was Ernie Pyle?

SOME DAY in the future someone is obliged to ask this question. Therefore, with a feeling of American pride, we are dedicating a part of this page to this very brave, very human and, without question, the most universally beloved battle-front reporter of World War II.

Wherever he went, from North Africa to the Pacific front, he was admired by the commanding officers, and every G.I. was Ernie Pyle's friend. He took his chances alongside of the front-line men and finally on April 18th of this year his number came up in the battle of Ie Shima as an important stepping-stone to the home islands of Japan. He was killed in action and was laid to rest alongside of his G.I. buddies, just as he wished it.

Why we are writing about Ernie Pyle in a water works magazine will become apparent. However, we wanted to write about Ernie Pyle just because he was so worth writing about, and so worth remembering. Already, then, with this intention in mind, it was a little startling to find upon reviewing the manuscript of George Symons' "Here and There" column for this issue that he had signed off with some pleasingly effective comments on Ernie Pyle. We, therefore, have lifted the following closing paragraph from Doc's "Here and There," which we liked so well, for incorporation in this editorial.

> "Somehow, I can't close this column without a word about a tragic happening last month. On the tiny isle of Ie Shima is a marker that says 'Here on April 18, 1945, the 17th Div., lost a buddy, Ernie Pyle'—not only that division but many others who knew him lost a friend. I knew Ernie Pyle like millions of others knew him, intimately, yes intimately, for all his readers knew him through his words, knew him for the 'brave man' he was, knew him as a great reporter, knew him for the hopes, the fears, the worries he had. He could, and did, spot a can of HTH and write about how it was used and about other water supply problems, and about other places and things, but mainly he wrote about people with a simple eloquence we shall wait long to see again."—G. E. S.

Yes, Ernie Pyle did write about water, and what a drink of good pure water meant to our G.I.s who had never had occasion to so highly appreciate before. In this connection a young sergeant after his return home from overseas very effectively summed up, in his own way, the meaning of good water to our G.I.s when he wrote in a letter to a buddie still at the front: "You'd find a lot of changes coming back to America now. But probably the more important are some of the unchanged little things you never thought much about until you got over there—things like the good water you can drink from the faucets. . . ."

We have an idea that thousands upon thousands of our veterans after this war are going to be far more "good water" conscious than even their "Dads" were. At least we hope that this *is* to be the case, for if we can have a citizenry who will continue to think about the "little things like good water" that can be drunk from the faucets, the war will have accomplished something which the water works fraternity has been all too sparsely successful in accomplishing.

As a closing thought in connection with the matter of this "little thing—good water," it behooves us here at home to spare no effort or expense in seeing that we *do* produce a "good water" and keep it that way if we are to expect the recognition and continued appreciation from a generation of fighting men who have no inclination to go through the remainder of their lives quenching their thirst with "chlorine cocktails" or concoctions even less palatable.

The Meters of Naugatuck

THE saving of 284,000,000 gallons of water each year sounds like it should be the theme for a smart meter ad headline—and, as a matter of fact, it should be.

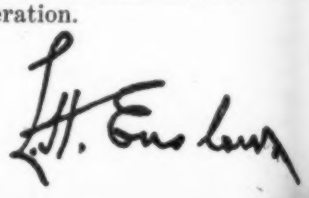
Saved—284,000,000 gallons annually through metering! is the boast of the Naugatuck Water Co. More interesting (and important to Naugatuck and the Water Company) is the fact that this saving through curtailment of domestic wastage not only meant that better than a $300,000 capital investment for enlarging the supply was avoided, but also that the 284,000,000 gallons per year became available to a top-flight war industry. Furthermore, this additional supply (recovered supply) could be sold at commercial meter rates to improve water sales income. Reads like a romance, doesn't it?

In this issue is the full story of "What War-time Metering Has Meant to Naugatuck" by Wm. H. Moody, General Manager of the Naugatuck (Conn.) Water Co. It is well worth reading because it tells how the company converted from a 100 per cent fixture rate schedule for all domestic water services to a 100 per cent metered system, with the warranty that the actual cost of metered water service to the 3,000 domestic users would not exceed the cost on the old fixture rate schedule of charges. All that the company sought was a means of "stretching" its available supply, which was then carrying a demand load dangerously near the safe yield expectancy. In the end, what actually was accomplished proved to be much more. What a story this makes for the meter manufacturers if they, in fact, need any more stories of the sort. What a story this may make for some industry which may have good use for excess water which a water utility might recover through an effective metering program without resort to development of additional new supply.

Looking at one or two of the most interesting features of Naugatuck's meters and the program which the first year reduced water leaving the mains through domestic services by the impressive figure of 60 per cent, Naugatuck's meters have straight reading registers which read in gallons rather than cubic feet. This evidences smart public relations consideration to our thinking, for the idea of buying 100 gals. (2 barrels) of water for a given price rather than a mere 13.3 cu. ft., has a distinct appeal. The fact that the customer can be invited to make his own meter accuracy test at home with a 5 or 10 gal. can at any time is another public relations advance.

In proving to customers that important wastage or leakage existed on their piping systems, requiring correction to avoid excessive meter charges, the use of a number of "Meter Master" flow recording units came in for readily convincing the customer of the existence of waste or leakage.

Perhaps the most effective of the public relations features was the unlooked for reduction of meter rates after the first year of operation.



CHICAGO "PACKAGE" SEWAGE PLANTS

Chicago "Package" Sewage Treatment Plant at an Aircraft Plant in the South.

OVER 10 YEARS OPERATING EXPERIENCE GUARANTEES SUCCESSFUL PERFORMANCE

100 PLANTS IN OPERATION

Chicago ""Package" Sewage Treatment Plants were especially developed twelve years ago for populations of 100 to 3,000. Over 100 plants have been installed. The experience our engineers have had with the operation of these plants is assurance of successful performance.

The Combination Aerator-Clarifier units used in "Package" Plants are furnished in six different sizes, and each size can be equipped with any one of several different sizes of propellers. These provide known oxygenation capacities capable of treating a wide range of sewage strengths.

*Patented

Complete engineering data are furnished Consultants so they can design "Package" Plants that will give crystal-clear effluent for any small community, housing project, institution, airport or industrial plant.

Operator training service by Chicago Pump Company Operating Sanitary Engineers goes with each plant.

Ask for full description and discussion with facts and figures for this type of plant which has been especially developed for the characteristic small community sewage flow and strength.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

2349 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**

Flush-Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers. Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

Plan on Hooker Chlorine For Your Postwar Sewage Treatment Plants

Chlorine is assuming increasing importance in sewage treatment. Plans now on the drawing boards of sanitary engineers, water works and sewage officials for new sewage treatment plants after the war indicate that chlorine is being considered in many phases of sewage treatment.

The reduction of B.O.D. and the retardation of putrefaction in the receiving water course, the disinfection of effluent before discharge are some of the operations where chlorine treatment has proved particularly effective. In many of the sewage treatment plants that are to be built when conditions permit, chlorine is specified for stabilization of raw sewage, odor control, prevention of filter ponding and increasing filter bed efficiency, improvement of sedimentation and sludge digestion.

Where your plans call for chlorine, insure uniform dependable results by specifying Hooker Chlorine. Because of its consistently uniform high quality, Hooker Chlorine has been the continued choice of water works and sewage officials. They have learned they can depend on each new shipment of Hooker Chlorine being up to the same high standards as the previous one.

Should your plans be in the making, or if you need help on present operations, Hooker's Technical Staff is at your service in answering your questions on the use of Chlorine and the other Hooker chemicals.

Chlorine

Bleach

Ferric Chloride

HOOKER CHEMICALS

HOOKER ELECTROCHEMICAL COMPANY

Buffalo Ave. & Ward St., Niagara Falls, N. Y.

New York, N. Y. • Tacoma, Wash. • Wilmington, Calif.

MEETINGS SCHEDULED:

IMPORTANT

Meetings, conferences, short schools, which will require hotel rooms or sleeping car accommodations for no more than 50 persons are considered as local or sectional meetings, and a permit from the Federal War Committee on Conventions to hold such meetings is not required. Therefore many conferences and short schools can be held without filing an application. Note the meetings of the South Jersey Supt's. Ass'n. and the N. Y. Sewage Wks. Ass'n. reported in this issue.

May 7-11—ST. LOUIS, MO.
American Water Works Ass'n. (Annual Conference Cancelled). However, there will be held a meeting of the Board of Directors for the purpose of transacting the essential business of the Association at some centrally located point—the place and date to be announced later.—Ed.

May 17—BOSTON, MASS. (Statler Hotel)
New England Water Works Association. Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston, Mass. (A. L. Shaw, Acting Sec'y.) (No June outing this year.)

May 18-19—GEARHEART, OREGON (Gearheart Hotel)
Pacific Northwest Section A.W.W.A. Sec'y, Fred Merryfield, Oregon State College, Corvallis, Ore.

New York Section, A.W.W.A. (Area Meetings)

May 22—ROCHESTER
May 23—SYRACUSE
May 24—ALBANY
May 25—WHITE PLAINS
Sec'y-Treas., R. K. Blanchard, 50 West 50th Street, New York, N. Y.

May 23—NEW YORK CITY, N. Y. (Tallmans Island Plant)
Long Island Section, N.Y.S.S.W.A. Sec'y-Treas., C. George Anderson, P. O. Box 174, Rockville Centre, N. Y.

May 25—OMAHA, NEBR. (Utilities District Bldg.)
Missouri Valley Section A.W.W.A. (Nebraska Region). Sec'y-Treas., E. L. Waterman, University of Iowa, 208 Engineering Bldg., Iowa City, Ia.

June 4-5—LEXINGTON, KY. (University of Kentucky)
Kentucky-Tennessee Section A.W.W.A. Sec'y-Treas., R. P. Farrell, Dept. of Public Health, 420 Sixth Ave. N., Nashville 3, Tenn.

June 5—WOLFEBORO, N. H. (Allen-A Camps, Lake Wentworth)
New Hampshire Water Works Association. Sec'y, Clarence Ferry, c/o Manchester Water Works, Manchester, N. H.

BEAN *Orchard & Crop* SPRAYERS

Protecting tomorrow's harvests from destruction

Here is an actual battle scene in the never-ending war against an enemy more merciless, insatiable and destructive than the Nazi or Jap! The enemy? *Insects and fungus diseases,* constantly attacking food crops all over the nation. Vital fighting equipment in helping to keep these pests under control are Bean Sprayers, embodying the famed Bean High Pressure Pump. Over 60 years' experience in building pest control equipment has been an important factor in establishing Food Machinery Corporation's enviable reputation for designing, engineering and manufacturing resourcefulness.

The FMC Bean Sprayer is another product of the Company that makes

PEERLESS PUMPS

Back of every FMC product is the extensive research, creative engineering and manufacturing skill of Food Machinery Corporation.

PEERLESS PUMP DIVISION... makers of Deep Well Turbine, Hi-Lift & Hydro-Foil Pumps for every purpose. Los Angeles, San Jose and Fresno, California; and Canton, Ohio.

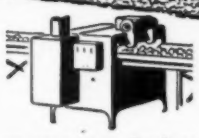
Other FMC Divisions and Typical Products

ANDERSON-BARNGROVER DIVISION. A complete line of machinery for canning and packing many types of foods. San Jose, Calif.

JOHN BEAN MFG. CO. DIV. AND BEAN-CUTLER DIV.... also make FMC Fog Fire Fighters. Lansing, Mich. and San Jose, California.

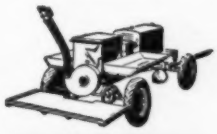
RIVERSIDE DIVISION. Produce Packing Equipment and Protective Processes, Automatic Box Making Machines. Riverside, Cal.

FLORIDA DIVISION... Produce Packing Equipment ... Flavorseal Protection & other processes. Dunedin & Lakeland, Florida.



TEXAS DIVISION. Produce Packing Equipt., Canning Machinery, Flavorseal & other processes for fresh produce. Harlingen, Tex.

FMC's "WATER BUFFALO" amphibious tanks. Seven of FMC's fourteen major plants make amphibious tanks or sub-assemblies.



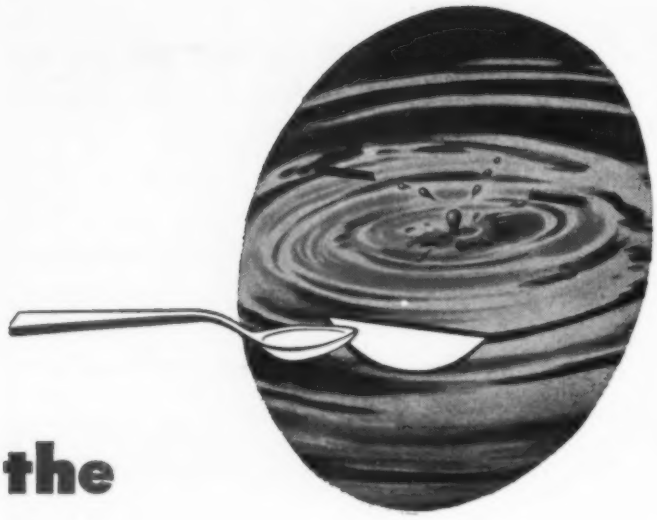
THE NIAGARA SPRAYER & CHEMICAL CO., INC. DIV. Insecticides. Middleport, N.Y.; Jacksonville, Florida; Burlington, Ont., Can.

SPRAGUE-SELLS DIVISION. A full line of equipment for nearly every packing operation on many types of foods. Hoopeston, Ill.

FOOD MACHINERY CORPORATION

EXECUTIVE OFFICES: SAN JOSE, CALIFORNIA

FMC Bean Sprayers are made by John Bean Mfg. Co. Division, Lansing, Mich. and Bean-Cutler Division, San Jose, California



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LIQUID

that cures

sick water!

Battle area and jungle streams fouled by disease-spreading germs . . . war-ravaged, epidemic-spreading water supply systems . . . flood waters laden with deadly bacteria . . . algae-infested water of industrial areas—*turgid, sick water that must be cured!*

SOLVAY Liquid Chlorine safeguards the health of fighters and civilians by effectively curing sick water of bacteria, algae, foul tastes, and odors. Army engineers and municipal health authorities have for many years depended upon this chlorine bactericide.

Serving on the fighting and home fronts, SOLVAY Liquid Chlorine keeps water fit for all needs . . . tomorrow, its war-time applications and benefits will help serve industry and municipalities better.

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SOLVAY

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LIQUID CHLORINE

June 5—**New England Water Works Association**
(No June Outing—Members invited to attend New Hampshire Ass'n. June Meeting.)

June 8—**New Jersey Section A.W.W.A.** (Cancelled.)

June 13—MILO, MAINE
Maine Water Utilities Association. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me. (Next meeting, Aug 8th at Northeast Harbor, Me.)

June 15—ALBANY, N. Y.
New York State Sewage Works Association (Capitol Section). Sec'y, A. S. Bedell, State Dept. of Health, Albany, N. Y.

June 16—SYRACUSE, N. Y.
New York State Sewage Works Association (Central Section). Uhl T. Mann, Ley Creek Sewage Plant, Syracuse, N. Y.

Sept. — —TORONTO, ONT. (Date and hotel later)
Federation of Sewage Works Ass'ns. (Annual Conference.) Exec. Sec'y, H. W. Wisely, 325 Illinois Bldg., Champaign, Ill. (Application to hold has been filed with War Convention Committee, Washington).

Sept. 12-13—FLINT, MICH. (Hotel not selected)
Michigan Section A.W.W.A. Sec'y-Treas., M. N. Gerardy, Dept. of Water, Water Board Bldg., Detroit 26, Mich.

Sept. 14—PITTSBURGH, PA. (Roosevelt Hotel)
Western Pennsylvania Section A.W.W.A. Sec'y-Treas., E. P. Johnson, 418 Flannery Bldg., Pittsburgh 13, Pa.
(Joint Meeting with)
Pennsylvania Water Works Operators Association. Sec'y., I. M. Glace, 22 South 22nd Street, Harrisburg, Pa.

Oct. 15-17—(Meeting place announced later)
Southwest Section A.W.W.A. Sec'y-Treas., George J. Rohan, The Rohan Co., Waco, Texas.

Nov. 5-7—CHARLOTTE, N. C. (Hotel Charlotte)
North Carolina Section A.W.W.A. Sec'y, D. M. Williams, Supt. of Water & Sewerage, Durham, N. C.

Nov. 8-10—ATLANTIC CITY, N. J. (Hotel Madison)
New Jersey Section A.W.W.A. (Fall Meeting.) Sec'y, C. B. Tygert, Box 178, Newark, N. J.

The 4 Freedoms of Water Pumping

FREEDOM
—from water shortage

Establish a dependable water source—a deep drilled well that taps the underground water strata, free from surface contamination. Install a Peerless Pump.

FREEDOM
—from excessive power bills

Highest pumping efficiencies are maintained by Peerless Pumps by reason of their fine engineering. Double bearings in the bowl and double impeller seals insure retention of original efficiencies and double the life of the pump.

FREEDOM
—from pump breakdowns

Rugged construction of Peerless Pumps, combined with precision of finish, insure dependability of operation throughout the year.

FREEDOM
—from costly repairs

Peerless Pumps are simplest in design. Perfect balance, exact fit, absence of destructive vibration, and foolproof construction, insure long life and minimum upkeep cost.

Capacities—10 to 220,000 gallons per minute.

Peerless Turbine Pumps can be installed in deep or shallow wells—operating by direct connected electric motor, geared or belted head—for pumping into pressure main, elevated tank or into open reservoir.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
Food Machinery Corporation

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HI-LIFT
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VALVES
HYDRANTS

VALVES: A.W.W.A. type, iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position. All rugged and dependable, made of best material with highest quality workmanship.

Hydraulically Operated: For remote control of operation and for quicker, easier opening or closing. Can be supplied in any of the standard sizes of M & H A.W.W.A. gate valves, either high or low pressure.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals. Dry top, revolving head, easy to lubricate. High efficiency because barrel diameter not reduced and there are no working parts or obstructions in waterway. SPECIAL TRAFFIC MODEL is designed to yield at ground line under impact, repair being simply renewal of breakable bolts and breakable coupling on stem.

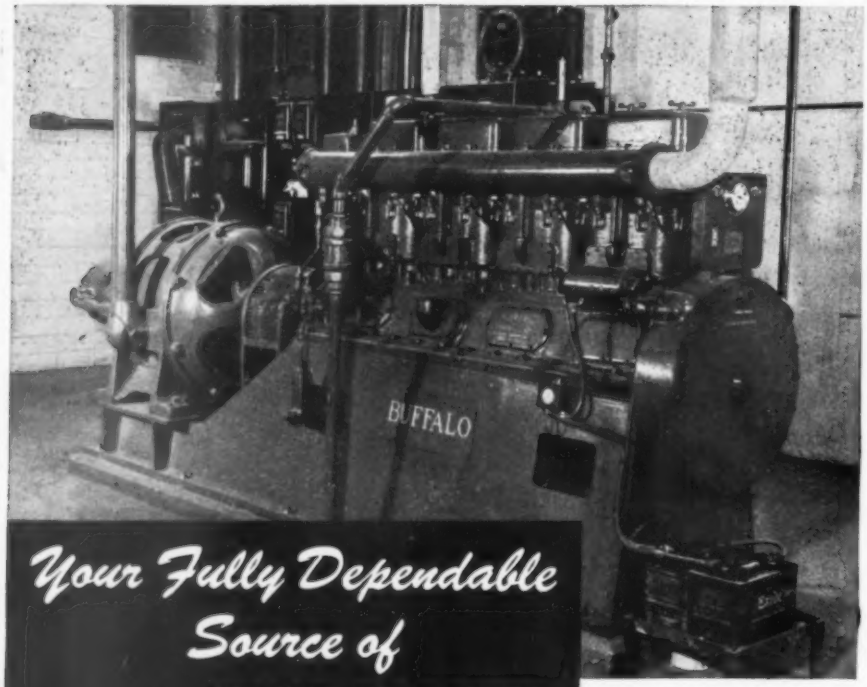
Write for Catalog No. 34

M & H PRODUCTS INCLUDE

FIRE HYDRANTS	SHEAR GATES
GATE VALVES	MUD VALVES
TAPPING VALVES	VALVE BOXES
WALL CASTINGS	FLAP VALVES
SPECIAL CASTINGS	SLUDGE SHOES
TAPPING SLEEVES	FLANGE AND FLARE FITTINGS
CHECK VALVES	FLANGED FITTINGS
FLOOR STANDS	B & S FITTINGS
EXTENSION STEMS	CUTTING-IN TEES

M & H VALVE AND FITTINGS COMPANY

ANNISTON, ALABAMA



Your Fully Dependable Source of STAND-BY POWER

An RAB-8 BUFFALO Engine-Generator Unit—for full automatic stop-start when main current fails—at Curtiss-Wright Airport Plant, Buffalo, N. Y., for emergency light and power.

BUFFALO ENGINES
ASSURANCE of PROTECTION

In hundreds of communities the name "BUFFALO" on stand-by engines is assurance of protection against power failure—in public service works, in private industries, in institutions, at airports, at radio stations and in telephone and telegraph communication systems.

For over forty years we have been accumulating this experience and applying it to steady improvement in design, in workmanship and in adaptability to the various duties required.

For the best evidence of their superiority examine BUFFALO ENGINE specifications and inspect installations where their performance can be observed. We invite engineers and others interested to write for complete data and references to installations in any field.

BUFFALO GASOLENE MOTOR COMPANY

DEPT. WW-55 BUFFALO 13, N. Y., U. S. A.

BUFFALO ENGINES
ASSURANCE of PROTECTION

BUFFALO ENGINES — 100 H. P. THROUGH 750 H. P.— IN GENERATOR AND PUMPING SETS FOR WATER WORKS — AIRPORTS — COMMUNICATIONS — FLOOD CONTROL — HOSPITALS — INSTITUTIONS — MINES — MOVABLE BRIDGES — THEATRES — SEWAGE PLANTS.

Here and There with Doc Symons

It was only a month or so ago that I wrote, "Help help—this column needs help from the boys in the field." Well, there hasn't been an avalanche of mail, but what has come in so far is well worth repeating.

For example, there was the letter from one of our favorite persons in the water and sewage field which said, "The following incidents occurred in connection with our sewer system last year. A series of explosions occurred one morning from about 2 until 8 o'clock. After the first explosion occurred, men were dispatched to take samples of the gas in the sewer in order to determine the cause of the explosions. One inspector sampled the gas at a manhole, turned around and walked 10 ft. when a terrific explosion occurred which blew the manhole ring out of the pavement and into the air in excess of 40 ft. in height.

"The manhole cover was blown high in the air over a house and fell on the ridge of the house second from the corner. The manhole cover went through the roof, through the attic floor, and came to rest on the top of a partition and in a lady's bedroom where she and several children, in various stages of dress and undress, were getting out of bed.

"The lady took one look, bundled up her offspring, called her husband and said, "Me go, you stay," and disappeared. She was unheard from for six hours and could not be enticed to return to her house for a period of three days.

"Directly across the street a man was preparing for work. He was dressed in a long heavy union suit with the vertical opening in the rear. In the act of seating himself as he was at the moment, he was totally unprepared for the explosion which suddenly displaced the contents of the white bowl through the open flap and into the 'red flannels.' His ex-

This battery of five (5) POTTSTOWN Blowers has been doing a continuous 24-hour-daily job for over 10 years—and this plant has *NEVER for a single moment* been without its required volume of air.

air
air
and
more air...
the eternal demand of
SLUDGE AERATION

The engineers of sewage disposal plants know the value of air—the unending need of air for sludge activation. And most of these engineers agree that their requirements of *unfailing* supplies of air for continuous sewage purification are delivered *best* by POTTSTOWN Rotary Blowers.

Efficient positive displacement with these POTTSTOWN Rotary Blowers is accomplished because their precision machining permits exceptionally close clearances on moving parts. Their efficiency is maintained during long life because there is no actual contact or friction between the impellers themselves—nor between impellers and casing interior. *No wearing parts here!*

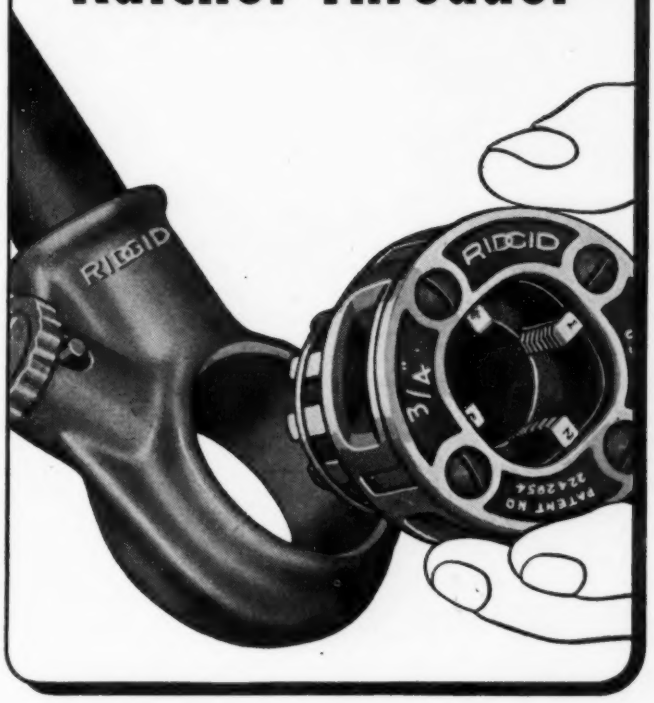
With friction eliminated, interior lubrication is unnecessary. Only clean air—uncontaminated by lubrication—is delivered to your filters or diffusers. No valves, springs, or other friction parts to wear out or to necessitate repairs. Simplicity of design, sturdy construction, precision machining—THESE FEATURES eliminate maintenance and adjustments, *even on daily 24-hour service!*

Write today for our new Bulletin P-100.

ALLEN BILLMYRE COMPANY, 449 Fayette Avenue, Mamaroneck, N. Y.

POTTSTOWN
ROTARY POSITIVE DISPLACEMENT
BLOWERS

You'll enjoy using this smart little RIDGID Ratchet Threader



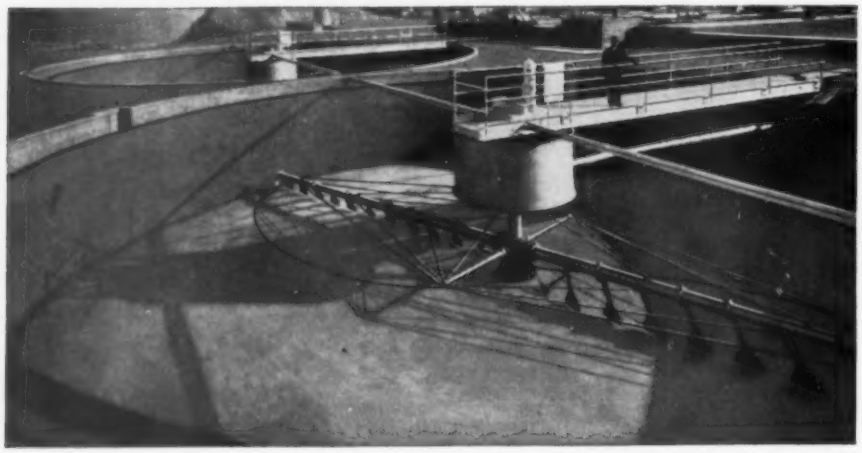
Die Heads lock in either side

● This 111R threader is a time-saver on pipe from ⅛" to 1¼". Click the size die head you want into the ratchet ring, from either side. No special dies needed for close-to-wall threads, just reverse the alloy steel chasers, easily removed also for regrinding. You'll like this efficient rugged little steel-and-malleable threader—ask your Supply House. We're trying our hardest to meet the big demand for RIDGIDS . . . your patience is greatly appreciated.

Handy carrier with any combination of sizes.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY · ELYRIA, OHIO, U. S. A.

SLUDGE REMOVAL CONTROL



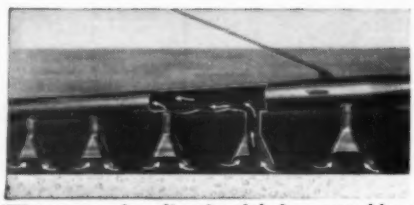
Rex Tow-Bro Sludge Remover in two 75-foot diameter Final Settling Tanks (Activated Sludge Process), Topeka, Kansas, Sewerage Treatment Plant. Chas. A. Haskins & Co., Kansas City, Mo., Consulting Engineers.

WITH THE REX TOW-BRO SLUDGE REMOVER

The Rex Tow-Bro Sludge Remover is the only device that assures accurate control of sludge removal over a wide range of withdrawal rates. This feature, combined with the gentle suction action of the Tow-Bro, provides the ideal equipment for handling light, flocculent solids over wide ranges of removal.

Sludge can be removed as rapidly as desired to prevent septicity within the tank, without disturbing the settling efficiency of the tank. In one revolution of the Tow-Bro, *all* the sludge may be removed from the *entire* tank bottom.

The Rex Tow-Bro provides—greater solids concentration, greater operating flexibility and a clearer, undisturbed effluent, all with lower installation and operating costs.



White arrows show direction of sludge removed from tank bottom by Rex Tow-Bro gentle suction action.

It will pay you to investigate the possibilities of the Rex Tow-Bro for your plant. Rex Sanitation Engineers will be glad to show you how you can benefit from the exceptional advantages of the Rex Tow-Bro. For complete information, write Chain Belt Company, 1610 West Bruce St., Milwaukee 4, Wisconsin.

REX **SANITATION EQUIPMENT**

Bar Screens • Traveling Screens • Conveyor and Tow-Bro Sludge Removers • Rapid and Slo-Mixers • Aero-Filter Distributors • Grit Collectors and Washers

CHAIN BELT COMPANY OF MILWAUKEE

Member of the Water and Sewage Works Manufacturers Association, Inc.

clamation was lost amid the wind and roar. Perhaps it is just as well."

* * * * *

May I call attention to the fact that last June this column said it agreed with the Ohio Section's suggestion that Wendell LaDue be the next AWWA Vice President—which he is. Any of you other sections want me to mention someone for next year? If you have a Wendell LaDue, say the word and look for a plug in H. & T.

* * * * *

Last month I was quoting from "Buckeye Sludge" put out by the Ohio Sewage Conference and said, "This issue edited by Jim Turner—or was it?" thinking the comment would smoke out the real editor. It did, for Jim Turner wrote, "I have just finished reading your column, 'Here and There,' and as usual have enjoyed it," (thanks, Jim), "but there is one little item in it that you should know the real truth about.

"This is in regard to 'Buckeye Sludge' and just who should have the credit for its publication. Our good Sec. Barney Barnes and I discussed the matter of getting out something in the way of a news letter to our members a number of times, but the original form and editing are all his handiwork. He asks me for an editorial, then gets some other big shot to write one and keeps mine for a time when he is turned down by someone else. Now don't get me wrong, I am not complaining about this; if he can get men like Mr. Berry to write editorials for our paper, more power to him. I just mention it to give you the lowdown on how very little credit is due me for the publication. Barney is so darn modest that he says he leaves his name off so if there are any complaints they will blame me for them."

* * * * *

While on the subject of "Buckeye Sludge," I noted therein that the Marble Cliffs Quarries Company of Columbus have as the picture on their 1945 calendar the group picture of those members of the Ohio Conf. who attended the 1944 conference meeting at Marion (sorry I couldn't go—I've always wanted to be a pin-up boy). - - - Art Niles turns up as a columnist writing a version of "My Day." - - - Barney Barnes turns lexicographer with this definition: Sewage Plant operator, n. One who is versed in the art of sewage treatment, chemistry, bacteriology, limnology, civil engineering, public relations, and can mow grass." - - - And Joe (somebody's favorite operator) says, "Keep your chin up, you are less apt to get your face splashed, and if at first you don't succeed, clean the darn pump out again." - - - Maj. M. W. "Tat" Tatlock is now G-2, Co. G, 2nd ECAR, APO No. 658—but what is ECAR?

* * * * *

Honest, folks, I hold in my files a golf card, signed by the players, showing the following scores for nine (9), yes, nine holes:

R. C. Clement	65
Shorty Germond	73
James H. Allen	58
Bob Mowry	79

This record-breaking game was played at Allentown, Penn., last month when the Penn. Water Works Operators Assoc. held a one-day session. How about a return match next Fall, fellows? This column will donate a cup to the man who shows the most improvement during the summer.

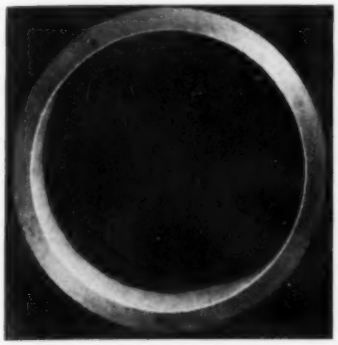
* * * * *

Some of you will, I hope, recall that in this column last January I expressed an opinion on the subject of antiquated systems of measure-

Cement-lined

MONO-CAST PIPE

Prevents Tuberculation



Cross-section of a sample of Cement-lined cast iron pipe.

Mono-Cast Cement-lined Pipe installed in the Summerville Test Line is periodically dug up for inspection. Repeated inspections over a period of years fail to reveal the slightest signs of incrustation from this water which is highly tuberculating. The cement lining of the pipe has remained smooth and consequently the value of the coefficient "C" remains practically constant.

Economical and long-lasting Mono-Cast Pipe may be had with a variety of joints to meet every condition. Write for full details.

AMERICAN CAST IRON PIPE COMPANY
Birmingham 2, Alabama
Sales Offices in Principal Cities

GREASE
FRIEND or ENEMY?

Grease saved is a friend... an aid in the manufacture of glycerine, soap, and medicine. Grease poured down the drain is a menace, clogging drain lines, disrupting service, interfering with proper sludge development.

Josam ***Cascade*** **GREASE INTERCEPTORS REMOVE TROUBLESOME GREASE**

Located at proper points in the drainage lines, Josam Grease Interceptors remove troublesome grease regardless of waste water temperature. Solids and sediment are evacuated and accumulated grease is easily removed. The more that are installed, the easier is your sewage problem. Types and sizes for all conditions. Write today for a copy of "Grease Interception" —Manual "A"

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Executive Offices, 320 Empire Bldg., Cleveland, Ohio • Manufacturing Division, Michigan City, Indiana
Representatives in all Principal Cities
JOSAM-PACIFIC CO. 705 Folsom Street, San Francisco, California — *West Coast Distributors*

THERE ARE NO SUBSTITUTES FOR JOSAM PRODUCTS

How Much Does A Patch Cost?

Flexible Machine Saved
52 CUTS IN THE STREET

Patches in the street are "SIGNS" of wasted time, money and labor because they're seldom necessary when modern Flexible pipe cleaning methods are used.

In the picture above, the Flexible equipment and crew, located in an out-of-the-way place, are cleaning a city pipe line without cutting into the street.

Every pipe cleaning job is different. That is why you should take advantage of Flexible experience and Flexible specialized equipment. A fleet of Flexible service trucks with complete crews and equipment are at your city's service.

Call or write your nearest Flexible representative. He will be glad to estimate the cost of cleaning all or part of your pipe line system.

Figure the cost of digging, the cost of back filling, the cost of detouring traffic, the cost of patching, the cost of repaving the street – these are the costs of an unnecessary patch in the street.

FLEXIBLE WILL CLEAN ANY PIPE FROM 2 TO 72 IN.

FLEXIBLE UNDERGROUND PIPE-CLEANING CO.

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1634 Harmon Place Minneapolis 3, Minn.
P. O. Box 694 Gulfport, Miss.
41 Grosvenor St. Hamden, Conn.

9059 Venice Boulevard
Los Angeles 34, California

401 Broadway New York 13
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P.O. Box 694, Pittsburgh
P.O. Box 165, Atlanta
147 Hillside Ter. Irvington, N. J.

Laying 4,500 ft. of 60-in. reinforced concrete pipe for outfall storm sewer at Municipal Airport, Waterloo, Iowa. Drainage contractor, Gjellefald Construction Co., Forest City, Iowa. Prime contractor, Concrete Materials & Construction Co., Cedar Rapids, Iowa.

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BUY AND KEEP MORE WAR BONDS

You get ample strength to resist loads and impacts, maximum hydraulic capacity because of smooth, true interior finish, and low annual cost when you specify concrete pipe for drainage, sewerage or water lines.

In addition, concrete offers the advantages of:

HIGH WEAR RESISTANCE to abrasion by suspended grit.

MINIMUM INFILTRATION AND LEAKAGE assured by tight joints and dense concrete.

MODERATE FIRST COST—simple construction.

Concrete pipe installations have long life with low maintenance expense which contribute to *low annual cost,* the true measure of economy in pipe lines.

Latest technical information on concrete pipe lines is available free in the United States and Canada.

PORTLAND CEMENT ASSOCIATION
Dept. A5-29, 33 W. Grand Ave., Chicago 10, Ill.

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

ment. Not many persons wrote in to agree or disagree, but in a recent letter from the new headquarters office of WSWMA (Cor. Maiden Lane & Broadway) Art Clark wrote that I had ignored the measurement of Time. Without space here to reproduce his letter, I've decided to devote most of the next column to these letters, including Art's, so if you want in on the melee you'd better write as soon as you receive this issue.

* * * * *

It was just about a year ago that this column issued the warning to the subscribers of **W.W.&S.** that they should not throw away the June 1943 (*Ref. and Data*) issue when the June 1944 (last year) issue arrived, for the latter issue contained none of the material in the former.

Now it's time to tell you that the line-up of articles for the **June 1945** issue has been picked and there's nothing in it that was in the **1944** issue. Not only do you need to have both the 1945 and 1944 issues, but there is a lot of material that ran in 1943 that won't run in 1945, so you'd better hang on to your **1943** issue, too. This year's index will be a consolidated one showing not only 1945 material but 1944, 1943, and other articles that ran before but not since 1943.

* * * * *

The closing item written for this issue of "Here and There" so pleased the Editor that he moved it to the editorial page—I hope you like it, too.

AMERICAN GAS BOILERS
STEAM AND WATER TYPES
FOR DIGESTER HEATING
SEE DATA PAGE IN ANNUAL REFERENCE SECTION
AMERICAN RADIATOR & Standard Sanitary
New York CORPORATION *Pittsburgh*
SALES OFFICES IN ALL PRINCIPAL CITIES

SAVE MONEY USE ACTIVATED ALUM and BLACKALUM

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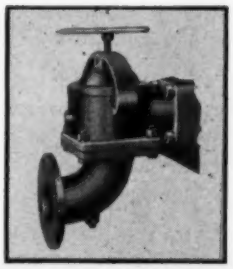
516 North Charles St.
Baltimore Maryland

CARTER *SLUDGE PUMPS*

DEPENDABLE · RUGGED · MODERN

DEVELOPED by CARTER engineers for the toughest of service, the CARTER plunger sludge pump has hundreds of satisfied customers in the water, sewage and waste treatment fields. Such desirable features as variable capacity thru stroke adjustment, babbitt lined eccentrics, oversized packing glands and connecting rods of one piece construction make a CARTER sludge pump the finest that money can buy.

Illustration at right shows all flanged type valve chamber . . . standard construction on all CARTER sludge pumps. Chambers are provided with lead impregnated ball valves, guaranteeing a longer life on the most severe service. Quick opening covers on chambers are provided to permit ready inspection.



• ***Write for Bulletin 816***

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A.W.W.A.

VOGT BROTHERS MFG. CO. Incorporated LOUISVILLE, KY.
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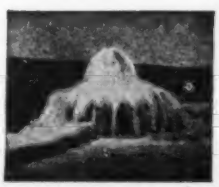
AERO-MIX

AERATOR—MIXER

A Size and Type to Fit Your Problem in Water or Sewage Treatment.



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HYDRO-TITE — The self-caulking joint compound that makes cast iron water pipe joints — strong — tight — flexible and everlasting. Used on thousands of miles of pipe with a record of more than 30 years without a failure.

•

FIBREX — The sanitary paper packing that is used like braided jute. Free from bacteria — treated with a water repellent —put up in 60 pound reels. 70 pounds of Fibrex takes the place of 100 pounds of braided jute.

•

HYDRAULIC DEVELOPMENT CORPORATION
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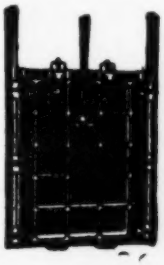
DRY BRAIDED
Fibrex

RODNEY HUNT



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Metal or timber sluice gates of all sizes and designs, approved by engineers everywhere. Improved gate stands and hoists for hand or motor operation. Also flap and mud valves, shear and filler gates, trash racks and rakes. Dependable canal equipment from dam to tail-race since 1840.

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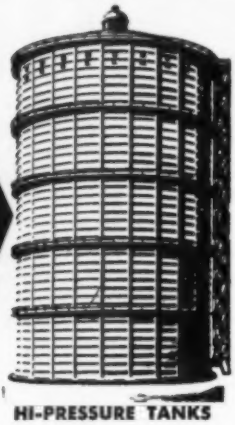
Submit your Special "STEEL STRUCTURES" Problems to us

Stacey Brothers' long experience and established policy of constant research have produced results in design, production, and field erection techniques that have definitely established their leadership in the fabrication of steel and its alloys. You profit from this policy thru more efficient designs, worthwhile weight reductions, and more stable structures with longer life.

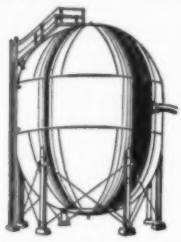
You can entrust your requirements for gas storage holders, storage tanks and bins, stand pipes, towers, and similar structures to Stacey Brothers with full assurance of satisfaction in both service and product.

If you are working up plans now for such equipment, our experience and recommendations may be of valuable help to you. Write us now—ask for Bulletin G-45.

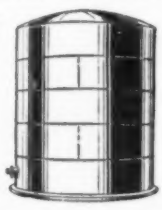
GAS HOLDERS



HI-PRESSURE TANKS

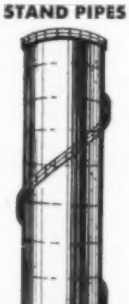


STORAGE TANKS



WATER TOWERS

STAND PIPES



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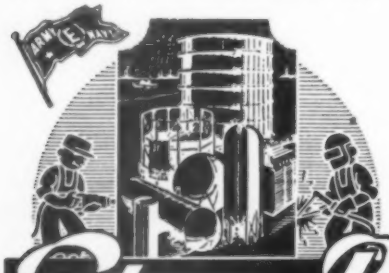
One of the Dresser Industries

5535 Vine St. Cincinnati 16, Ohio



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MANUFACTURERS' and EQUIPMENT News

Orchard Honored on 30th Anniversary

The one and only William J. "Bill" Orchard, General Manager, of Wallace and Tiernan Co., Newark, N. J. was honored recently by his fellow workers on the occasion of his 30th anniversary with the company. On April 16th, "Bill" became the 5th member of the W&T Diamond Club to attain a 30-year service pin, appropriately presented by M. F. Tiernan, president of the company.

W. J. Orchard

Other members of the Diamond Club, all of whom have more than 10 years service, presented Mr. Orchard with a solid gold cigarette lighter, engraved to commemorate the occasion. In addition to thirty

ZECO GREENSAND ZEOLITE

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. COREXITE mineral for corrosion control and water stabilization.

ZEOLITE CHEMICAL CO.

Sales Office 140 Cedar St. New York, N. Y. Factory Medford, N. J.

Pioneer Producer of GREENSAND ZEOLITE MINERAL

WESTON

GASKET AND FORM

The Perfected Method for Making Sewer Pipe Joints of Cement

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

L. A. WESTON Adams, Mass.

..for ACCURACY and TROUBLE-FREE OPERATION

INSIST ON THE WILSON HYPO-CHLORINATOR

Engineered and Manufactured by

WILSON

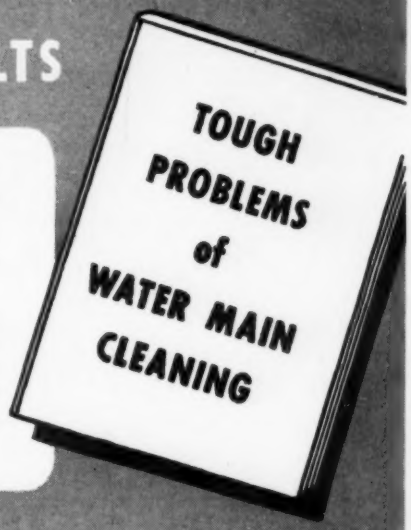
CHEMICAL FEEDERS, INC.

203 CLINTON STREET BUFFALO 4, N.Y.

IT'S AN OLD STORY TO US

TEST OUR PROVEN FORMULA —

EXPERIENCE + EQUIPMENT = RESULTS



NATIONAL has the Experience — Each NATIONAL Superintendent is a man of long experience and has the added benefit of the Company's knowledge gained through 38 years — 1907 to 1945.

NATIONAL has the Equipment — For 38 years NATIONAL has been perfecting equipment to meet all sorts of pipe cleaning conditions.

NATIONAL GETS RESULTS — A NATIONAL pipe cleaning job guarantees the removal of all deposits, incrustations, tubercles and growths and restores the pipe to almost 100% of its original carrying capacity. Greatly reduced operating costs save the cost of cleaning many times over.

The NATIONAL METHOD

National Water Main Cleaning Co.

30 CHURCH STREET, NEW YORK 7, N. Y.

1221 Mortgage Guarantee Bldg., Atlanta 3, Ga.
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The Only 100% Self Propelling Sewer Cleaning Machine

Reduces Cleaning Time 75% to 80%

Your own maintenance men can restore your sewer lines to full capacity with this simple, sanitary and economical method. All work is done from the street level.

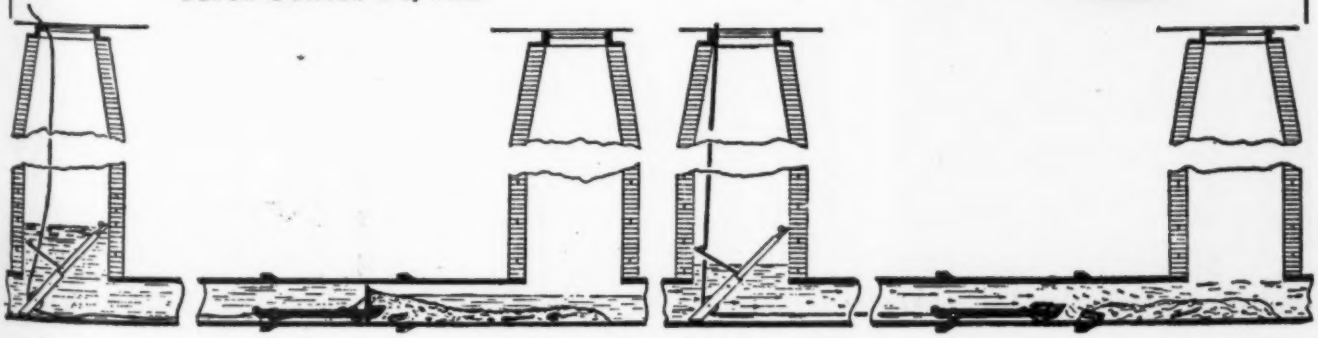
The Sewer Scooter is not pulled or pushed but the head pressure of the water in the line furnishes the motive power, often a six inch head is enough, but if the flow is small more water may be added. The CONTROLLED FLUSHING by the hinged, rubber edged shield as it progresses, removes all the accumulated sand, rocks and broken rods and leaves nothing behind. It Passes obstructions and plumbers taps and can be used as an emergency stopper during repairs.

SEWER SCOOTER—
U. S. Patent 2198823

Sizes from 8" to 36" and larger on order
Write to us for detailed information

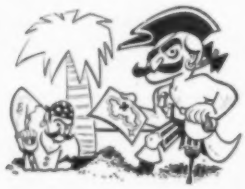
J. C. FITZGERALD

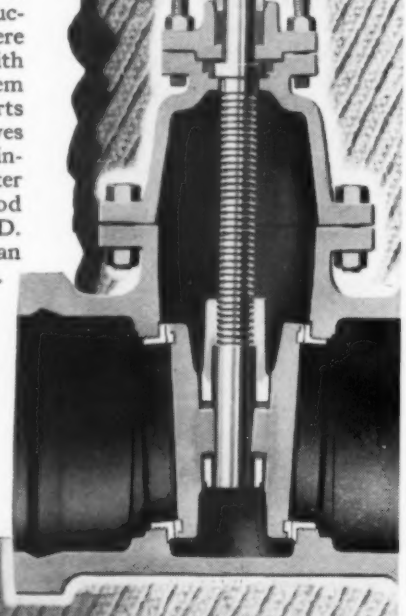
Coral Gables 34, Fla.



BURIED TREASURE

Buried deep underground, R. D. Wood gate-valves are the "treasures" of many a water department. They stay buried for years, get little attention, little operation. But when the time comes, they work. Their record for easy, dependable performance stretches back generations ago when they were first introduced to waterworks engineers. They are widely used today, because operating and maintenance-men recognize their rugged construction, their practical design. There are no pockets that can fill with sediment and scale to make them stick. There are only three parts in the internal mechanism. Valves are fully bronze-mounted to insure easy operation . . . year after year. Like the R. D. Wood "Mathews" hydrant, the R. D. Wood A.W.W.A. gate-valve can be counted on to do a good job.





R. D. WOOD COMPANY

400 CHESTNUT STREET, PHILADELPHIA 5, PA.

MANUFACTURERS OF MATHEWS HYDRANTS AND SANDSPUN PIPE (CENTRIFUGALLY CAST IN SAND-MOLDS)

Established in 1803

years' service with W&T, "Bill" also has a record of long service to the AWWA and FSWA as well.

Harry Siebert, Young War Veteran, Joins Neptune Meters

The Neptune Meter Co. announces that Lieutenant Harry J. Siebert, son of "Mike" Siebert, well known Neptune District Mgr., of Richmond, Va., is being employed on the Neptune sales staff. He will represent Neptune in North and South Carolina.

Harry J. Siebert

Young Siebert, now a veteran of World War II, after completing courses at Virginia Military Institute (Gen. Marshall's school), was

ODOR and TASTE are health factors too...

The WATER SUPPLY that pleases nose and palate is an important contribution to community health — people drink more of it.

ESOTOO* is the answer to a simple, sure, and more economical method of controlling residual chlorine — especially in "break-point" chlorination.

ESOTOO* is the Ideal De-Chlorinator.

**ESOTOO is "Virginia's" Trade Name for Liquid Sulfur Dioxide.*

VIRGINIA

VIRGINIA SMELTING COMPANY

WEST NORFOLK, VIRGINIA

ANTHRAFILT

A Filter Medium For All Purposes

ANTHRACITE EQUIPMENT CORP.

101 Park Ave. New York

H. G. Turner Research Engineer

STATE COLLEGE, PA.

EDSON DIAPHRAGM PUMPS

Hand Sizes 2", 2½", 3", 4"
Power Sizes 3" and 4"
Open Discharge or Force Pump
Edson Special Suction Hose
Red Seal Diaphragms
Strainers and Foot Valves
Hose Spanners—Adapters

THE EDSON CORPORATION

Main Office and Works: 49 D St. South Boston, Mass.

New York: 142 Ashland Pl., Brooklyn

commissioned 2nd Lieut. of Cavalry, May, 1942. From further training at Ft. Riley and in Texas he went overseas as 1st Lieutenant with a Mechanized Reconnaissance Unit of the 1st Army. He took part in the initial Normandy invasion, was injured in combat in Northern France, returned to England and then to the U. S., where he was discharged as a casualty.

A letter from his Dad—"Mike" in Richmond—says, "Boy, and are we glad to have him back!" Us, too, Mike!

W. H. Moeller Becomes Am. Well Works' N. Y. Distr. Mgr.

Mr. Lee H. Chamberlain, Eastern Manager for American Well Works of Aurora, Ill., has just announced the appointment of W. H. Moeller as manager of the company's New York District, with headquarters in New York City.

W. H. Moeller

The New York District includes Albany and Schenectady to the north and Trenton, N. J., to the south, and all of Long Island.

The W. K. Snowden Co. will continue as special representatives in the New York District for American Well Works in the water and sewage

The *Coagulant* that *Cuts Costs!*

TENNESSEE CORPORATION Ferri-floc

Ferri-floc . . . the ferric coagulant that is successfully and economically used in sewage treatment throughout the United States. Take advantage of modern plant research and findings: use Ferri-floc. Tennessee Corporation's technical staff will be glad to help you with your specific problems. Write to us today. The consultation service is free, of course.

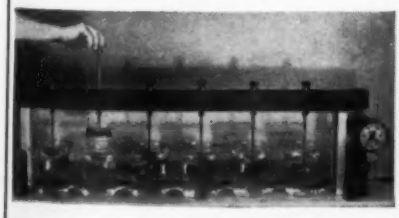
The Mark of Quality

TC TENNESSEE CORPORATION

Tennessee Corporation

ATLANTA, GEORGIA LOCKLAND, OHIO

THE *Phipps & Bird* LABORATORY MIXER . . .



IS the important piece of equipment in the Modern Water Works Laboratory. Now being used by leaders in water works research. Many superintendents and chemists have been able to reduce their chemical costs by the control of chemical dosages with this mixer. Write for literature.

PHIPPS & BIRD, INC. Richmond, Va.

STOP JOINT LEAKAGE WITH CARSON CLAMPS AND MECHANICAL JOINTS

Charcoal iron bolts for Cast Iron Pipe and Fittings. Write for Prices.

Carson-Cadillac Co.

1221 PINSON ST. BIRMINGHAM, ALA.

TAPAX

The ORIGINAL and FINEST....

Manhole Cushion U. S. Pat. No. 2,050,050 offers you the simplest solution for noisy, rattling covers. Easy to install. Lasting — Economical.

Write for story of Tapax and Trial Offer.

TAPAX MFG. CO., INC.

MAMARONECK NEW YORK

Effective IMMEDIATELY

"Varec" approved

PRESSURE AND VACUUM RELIEF VALVES WITH FLAME ARRESTERS

are again available in

ALUMINUM

"VAREC" Research protects users of "VAREC" Pressure and Vacuum Relief Valves and Flame Arresters. Adapting the application of Aluminum to this field, in 1928, "VAREC" Laboratories and Engineering skill are working ceaselessly to develop greater service potentialities from the company's products. Experience gained in unprecedented wartime obligations, added to years of pioneering, is now being reflected in the service of "VAREC" equipment.

The Pace Setter Since 1928

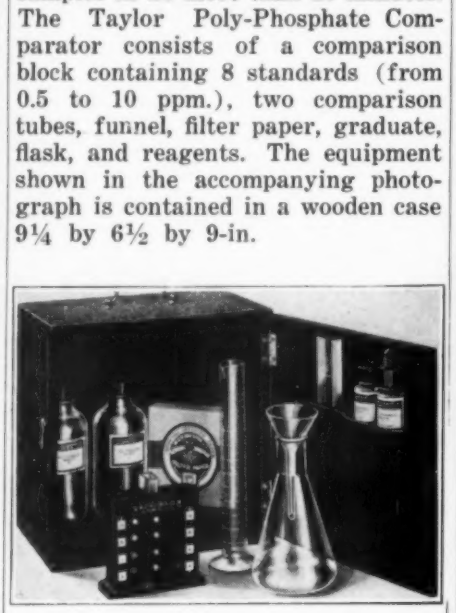
THE VAPOR RECOVERY SYSTEMS CO.
COMPTON, CALIFORNIA
New York City—New Orleans, La.—Houston, Texas
Tulsa, Okla.—Agencies Everywhere

fields, operating under Mr. Moeller's direction.

Mr. Moeller has long been identified with engineering and sales of hydraulic and electrical machinery in the New York District and is, therefore, already known to many.

Poly-Phosphate Comparator

By a simple comparator, developed by the W. A. Taylor Co. of Baltimore, Md., it is now possible to determine the concentration of the poly (glassy) phosphates such as hexameta, pyro, septa, etc., in water samples in no more than 20 minutes. The Taylor Poly-Phosphate Comparator consists of a comparison block containing 8 standards (from 0.5 to 10 ppm.), two comparison tubes, funnel, filter paper, graduate, flask, and reagents. The equipment shown in the accompanying photograph is contained in a wooden case 9¼ by 6½ by 9-in.



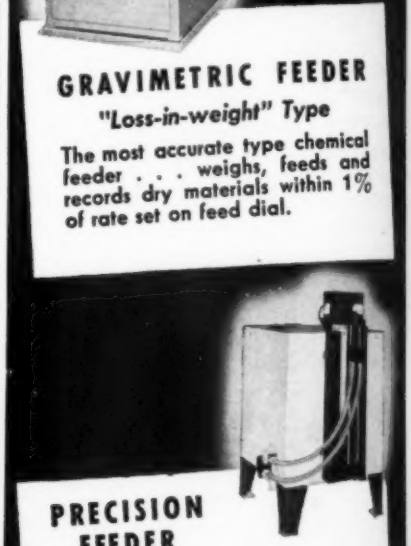
Inasmuch as low concentrations of poly-phosphates are coming into more and more general use for corrosion and encrustation control, this simple tester should find a ready use. The technic is to convert the residual poly-phosphate to the ortho-phosphate and determine the total phosphate present. From this value the ortho-phosphate present, as such (determined on a cold sample simultaneously) is subtracted. The new comparator may be obtained from W. A. Taylor & Co., 7300 York Road, Baltimore 4, Md.

All Aluminum Utility Ladders

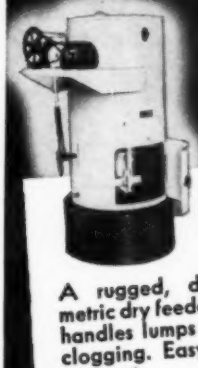
A complete line of utility ladders in all-aluminum tubular rail and channel rail construction is being announced by the Duo-Safety Ladder Co. of Oshkosh, Wis., as again available for immediate delivery. These ladders are featured in a new AL 45 Broadside showing Heavy

NEED A CHEMICAL FEEDER? *Specify an* OMEGA

GRAVIMETRIC FEEDER
"Loss-in-weight" Type
The most accurate type chemical feeder . . . weighs, feeds and records dry materials within 1% of rate set on feed dial.



PRECISION FEEDER
For Liquids
A true volumetric feeder, accurate within 1% for feeding solutions of hypochlorite, Calgon, Copper Sulphate, Ammonium Sulphate, etc. by gravity . . . feeding range, 100 to 1.



UNIVERSAL FEEDER
A rugged, dependable Volumetric dry feeder, simple in design, handles lumps or powder without clogging. Easy feeding rate adjustment.

The Omega line of chemical feeders is complete. Write for Bulletins

Sincerely
OMEGA MACHINE CO.
(Division of Builders Iron Foundry)
10 CODDING ST., PROVIDENCE 1, R. I.

Duty, Light, and Medium Industrial types in both single and extension models.

The availability of Folding Ladders, Marine Boarding, Scaffolding, Light Telephone and Utilities Ladders plus a Heavy Aluminum Platform Stepladder is to be announced very shortly. For illustrated literature on lightweight aluminum ladders for utilities and industry, write Duo-Safety Ladder Corp., 809 Ninth St., Oshkosh, Wis.

Peckworth Made Managing Director, Amer. Concrete Pipe Assoc.

Effective April 1, Howard F. Peckworth assumed the position of Managing Director of the American Concrete Pipe Association, with offices in the Builders Bldg., Chicago. Mr. Peckworth leaves the position of Assistant to the Secretary of the Am. Soc. Civil Engrs. He was Editor of *Civil Engineering* prior to that. As Asst. to the Secy. of ASCE, Mr. Peckworth is known to engineers throughout the country, particularly

Howard P. Peckworth

for his work in connection with studies of the problems posed by efforts to unionize professional engineers.

At the same time Mr. T. J. Kauer was appointed Asst. Managing Director of the Amer. Concrete Pipe Assoc. Mr. Kauer has been asst. to the President and Washington representative of the Association since 1941 and will continue his office in the Munsey Bldg., Washington, D. C.

Cooper-Bessemer Supercharges Gas Engine

By a new engineering development, The Cooper-Bessemer Corp. of Mount Vernon, O., has made possible the supercharging of a gas en-

SMITH

INSERTING VALVES

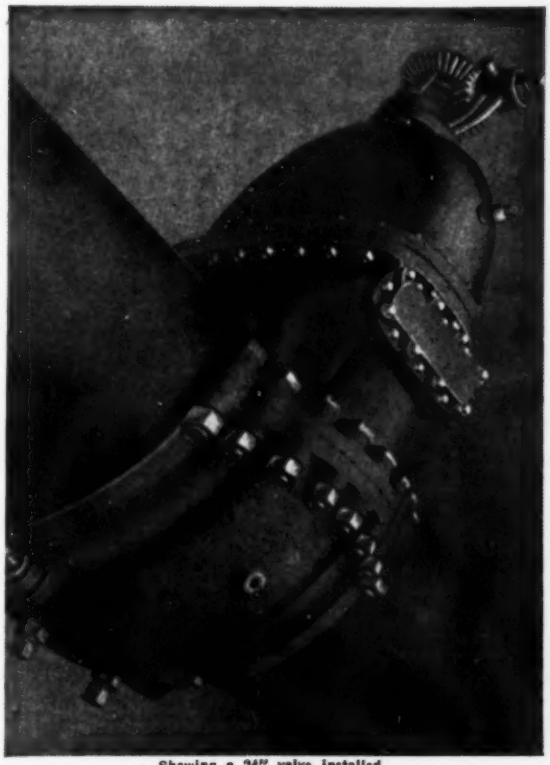
THE A. P. SMITH MFG. CO. EAST ORANGE, N.J.

Symbol of Quality Since 1889

NO SHUT-DOWNS NECESSARY!

Water shut-offs mean Industrial shut-downs, and this in turn impedes the war effort. These shut-offs are not necessary when a valve insertion is made.

With a Smith Valve Inserting Machine you can insert valves with the service at full pressure. These machines are made in 6 sizes for inserting 4" to 36" valves, are simple and easy to operate and do a surprisingly quick, clean job.



Showing a 24" valve installed horizontally under pressure.

OTHER SMITH PRODUCTS
Valves and Hydrants — Valve Inserting Machines — Tapping Sleeves — Tapping Valves — Hat Flanges

Write for Catalog

Branches

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THE A. P. SMITH MFG. CO., EAST ORANGE, N. J.

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

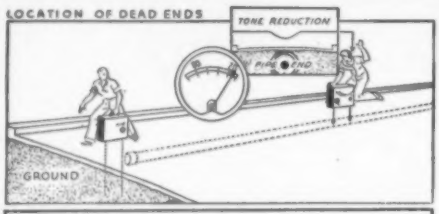
KNOWN AROUND THE WORLD AS THE SIGN OF EXCELLENCE IN WATER TREATMENT EQUIPMENT

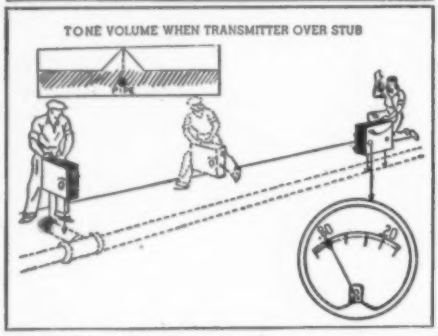
The years of experience behind the Roberts nameplate is your assurance that any water rectification problem is expertly handled to your best advantage. As manufacturing and installation engineers, the Roberts organization is equipped to meet your exact needs regardless of the size of the equipment or the complexity of the problem.

GRAVITY FILTERS • SOFTENING PLANTS AND EQUIPMENT • PRESSURE FILTERS
ZEOLITE SOFTENERS • SWIMMING POOL RECIRCULATING APPARATUS
SPECIAL WATER TREATMENT EQUIPMENT

We invite your inquiries

ROBERTS FILTER MANUFACTURING COMPANY • *Darby, Pa.*





M-SCOPE

Buried Pipe Finder and Leak Detector

FREE 16 PAGE BOOKLET UPON REQUEST

The M-SCOPE consists of a specially designed radio Transmitter and Receiver, with conductive wire. In operation, the Transmitter sends out a continuous signal, and when there is no metal between Transmitter and Receiver, a definite volume of sound is heard in the Receiver earphones and the meter (mounted on Receiver) gives a definite reading. If a metal object lies between the two units, sound in earphones is louder and meter reading higher—and the pipe or other metal object is located.

The M-SCOPE is solving — successfully — the varied problems involved in the development, operction and maintenance of buried pipe and cable systems and is in daily use by representative organizations in such important groups as:

- **Government Projects**
- **Municipalities**
- **Sewerage and Water Plants**
- **Consulting Engineers**
- **Airports**
- **Public Utilities**
- **Industrial Plants**
- **Iil and Pipeline Companies**

Write for further particulars and booklet:

FISHER RESEARCH LABORATORY

Direct Teletype **PALO ALTO, CALIFORNIA**

THE DOW CHEMICAL COMPANY

MIDLAND **MICHIGAN**

gine while permitting the instantaneous conversion from the use of either oil or gas fuel.

This new development will benefit stationary power plants by concentrating greater horsepower into less space, thereby reducing building and foundation costs. Tests revealed that on an LS-8 cylinder Gas-Diesel engine with an ordinary rating of 1,100 hp., supercharging increased the rating up to 1,600 hp. at 327 rpm.

With the increased use of gas and Diesel engines in sewage plants, for prime mover or standby purposes, the advent of this higher rated engine capable of operating on either gas or oil should be of considerable interest.

Hayes Kuhns' 25th Anniversary With Leadite

Hayes R. Kuhns, of Killbuck, Ohio, popular representative of the Leadite Co., as well as a spark plug and membership chairman extraordinary and Trustee of the Ohio Section AWWA says, "Twenty-five years looks like a long time in the future, but after a quarter of a cen-

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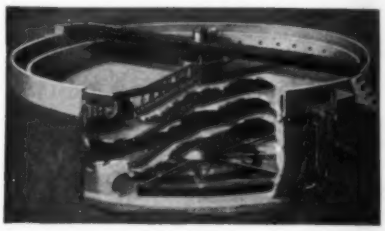


P.F.T. Clarifiers for Rapid Precipitation of Sewage Solids

The P.F.T. Tray Clarifier embodies a design which affects the continuous rapid separation of the solids and liquid in sewage; and the immediate removal of the clarified effluent. A series of shallow settling areas over which the sewage is spread assures speedy precipitation. Its high rate of flow provides maximum capacity in minimum space; reducing the construction and operating costs of clarification equipment.

Write for Bulletin No. 210 containing complete information, including operating results.

P.F.T. **Pacific Flush-Tank Company**
4241 Ravenswood Ave., Chicago, Ill.
New York Charlotte, N. C.

tury with Leadite it seems to have passed all too quickly." Hayes made this observation on the occasion of his silver anniversary with his company last April 15.

H. R. Kuhns

It was in March 1920 that Mr. Kuhns, who had been working for the Penna Water Co. in Wilkinsburg, Pa. since 1903, met Geo. McKay, Jr., Pres. of the Leadite Co., in the Wm. Penn Hotel in Pittsburgh and received instructions that the whole United States was to be his territory.

Not only has Hayes Kuhns sold a lot of his product in this past 25 years, but he has also sold himself to a host of friends who wish him well for his next quarter century.

LITERATURE AND CATALOGS

It was only a short time back that we announced in these columns the **Worthington Dual Fuel Engine** of the Worthington Pump and Machinery Co., and now comes a mimeographed bulletin on the subject. This twelve-page bulletin explains how, by one revolution of a single control wheel, conversion of one fuel to another is accomplished. The bulletin goes on to describe the simplicity, flexibility, and instant conversion, as well as low pressure fuel gas supply and economies.

Applications of this new type gas-Diesel engine, or converted gas engine, which operates on either oil or gas, include sewage plants, where this particular engine is handy to have available when gas supplies drop off for one reason or another, or where engine operation is desired before sludge digestion and gas production has been established. These

CEMENT GUN COMPANY

"GUNITE" CONTRACTORS

GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.

PRE-STRESSED "GUNITE" WATER TANK

The water storage tank shown above was built by us of "GUNITE" in 1944. The wall and dome ring girder are pre-stressed. The dome roof is also "GUNITE." It is 90' in diameter and 25' deep, and is bottle tight.

We have built scores of similar pre-stressed tanks and stand-pipes for the storage of various liquids, and also pre-stressed silos for the dry storage of chemicals.

Our 72 page bulletin 2300 describes dozens of "GUNITE" jobs of many types. Write for your copy.

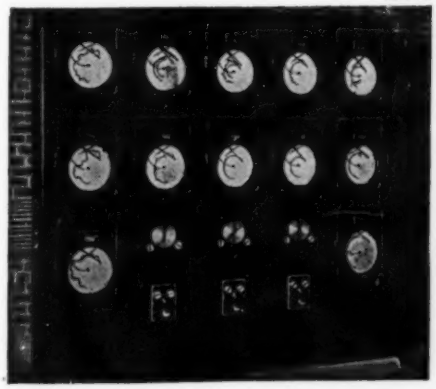
MANUFACTURERS OF THE "CEMENT GUN"

THE *Bailey Synchro-Meter* GIVES YOU *Flexibility* IN METERING APPLICATIONS

● This meter panel includes both direct mechanically operated Fluid Meters and Bailey Synchro-Meters, which are electrically operated by remote transmitters.

Wherever you have need for a central meter panel incorporating both mechanically and electrically operated Fluid Meters, it is possible to maintain uniformity and neatness by employing this system of transmitting meter and recorder readings.

MU-17



Readings of flow, pressure, temperature, liquid level and other factors are accurately and quickly transmitted from out-of-the-way places to the receiving indicator, recorder or integrator by the Bailey Synchro-Meter.

This electrical mechanism which is completely described and illustrated in Bulletin No. 194-A, can also be used to eliminate the necessity of running high pressure piping up to meter and control panels.

Write for your copy of this new Bulletin.

BAILEY METER • COMPANY •

1072 Ivanhoe Road, Cleveland, Ohio

BAILEY METER COMPANY LTD., MONTREAL

84" pipe—Spring Lake, N. J.

FLANGED PIPE

FLEXIBLE JOINT PIPE

BELL & SPIGOT PIPE

SPECIAL CASTINGS

SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

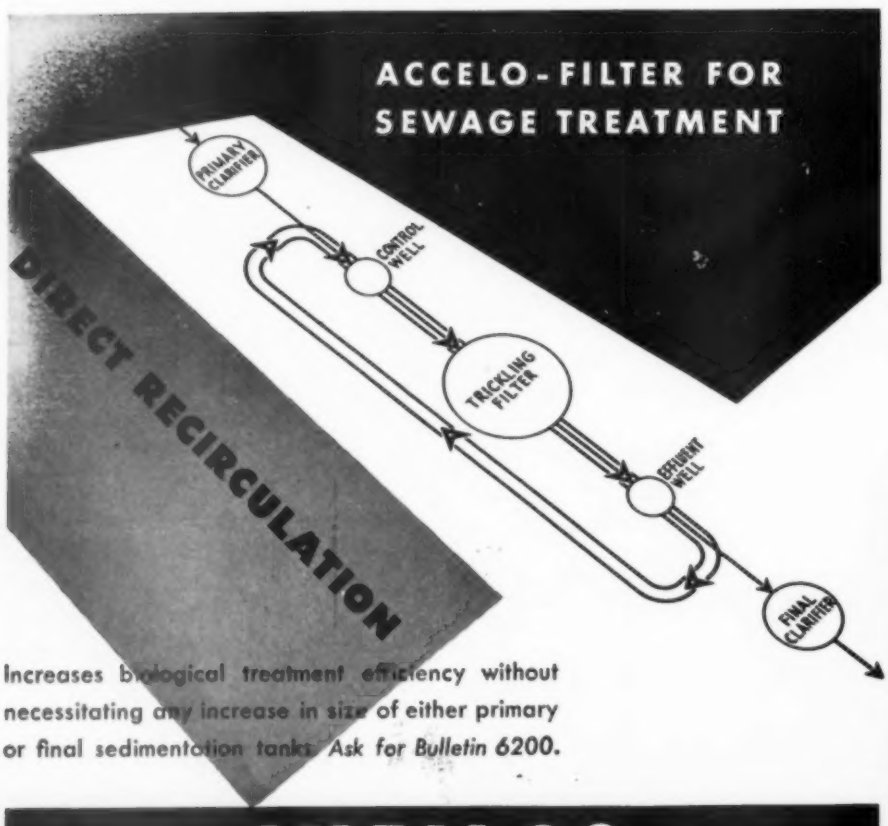
CAST IRON PIPE

SIZES 2" TO 84"

Warren Foundry & Pipe Corp.

11 Broadway, New York

Warren Pipe Company of Mass., Inc.



Increases biological treatment efficiency without necessitating any increase in size of either primary or final sedimentation tanks. *Ask for Bulletin 6200.*

INFILCO

INFILCO

INCORPORATED

325 W. 25TH PLACE, CHICAGO 16, ILL.

engines also have applications in fields outside of water purification and sewage treatment.

This bulletin, which may be obtained from the Worthington Pump and Machinery Corp., Adv. Dept., 744 Broad St., Newark 2, N. J., also contains a sectional diagram of an engine installation and a graph showing the increased hp. and decreased consumption of fuel per bhp. hour.

A single sheet labeled H.R.-1, Feb., 1945, sounds like it ought to be a congressional bill, but delineates the advantages of **"Hyde-Ro" Ring,** the rubber ring for packing B & S cast iron pipe joints. According to this sheet issued by, and obtainable from, the Atlas Mineral Products Co. of Mertztown, Pa., these "Hyde-Ro" Rings give flexibility, prevent contamination, hold back water, are easy to install, economical and convenient to store. "Hyde-Ro" (pronounced *Hydro*) Rings are manufactured for 4, 6, 8, 10 and 12-in. cast iron pipe.

According to the Fibre Conduit Co., 292 Madison Ave., New York, N. Y., in Catalog No. 303, you should specify **Orangeburg Fibre Pipe** for drainage where tight joints are necessary, for corrosive wastes, for house connections, for septic tanks, filter beds, irrigation and subsoil drainage, and downspouts.

This bulletin tells how this pipe is made from 25 per cent cellulose and 75 per cent coal tar pitch; the cellulose is formed, dried, placed under a vacuum and impregnated with the hot coal tar pitch. There isn't space here to tell about the general properties and characteristics, but it resists corrosion, has low friction loss, has good mechan-

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ical strength, and resists root growth; nor is there space to tell how tight joints may be made to prevent infiltration, or how it may be joined with other types of pipe.

This bulletin, which we don't recall seing before, also contains specifications and information on the perforated fibre pipe for septic tank filter beds, farm and muck land drainage, and foundation footing drains. There are some don'ts about using this type of pipe, but you can read these yourself when you receive your copy after writing for Bull. No. 303 to the company at the above address.

One of the most recent releases to come to our desk is Bulletin 318B, **Builders "Flo-watch,"** an eight-page item issued by Builders Providence, Inc., Providence 1, R. I., to acquaint the field with the outstanding features and many applications of these devices for recording and measuring flows.

Accurate, attractive, and fast moving, the Flo-watch line includes the following types of instruments: Recording; Recording and Indicating; Recording and Totalizing; and Recording, Totalizing, and Indicating. The bulletin shows the mechanics, the operation, and the application of the various meters. Combinations with Venturi tubes, Kennison Nozzles, Air Relays, Chemical Feeders, etc., are possible. A letter or post card to the company will bring one of these comprehensive bulletins in your mail.

Not too long ago we wrote a review of a little sheet on chlorinators and allied equipment manufactured by the Chemical Equipment Co. of Los Angeles. That little folder intrigued us so we wrote for "additional bulletins" of the company. When the package came and we opened it to find a neatly bound folder containing a dozen or so bulletins, we realized that we had really asked for and received "something."

There is Bulletin No. 300-1 on **Chemco Type M-1 Solution Feed Chlorinator;** Bull. S300-3 on Chemco **Type M-3 Solution Feed Chlorinator;** Bull. No. 300-3 (similar to S300-3); Bull. No. 300-5 on Chemco **Type M-5 Chlorinator;** Bull. No. 200 on Chemco **Sand Pressure Filters;** Bull. No. 700 on Chemco **Balance Inlet and Outlet Recirculation System** (for swimming pools); Bull.

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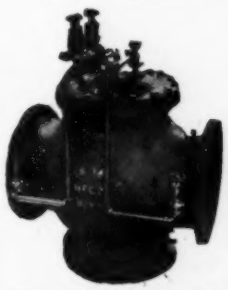

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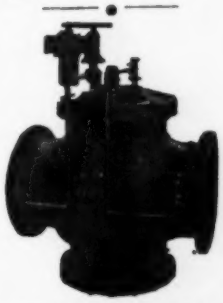

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No. 400 on Chemco **Suction Sweeper**; Bull. 700-B on **Swimco Service** (for swimming pool service particularly on the west coast); Bull. No. 1200-A on the Chemco **Master Line Solo-Multiport Valve** for water softener or filter plant; Bull. No. 1200-B titled: **Why Tolerate Hard Water?**

While much of this equipment has been developed in connection with swimming pool operation, it is obvious from the testimonial letters in the folder that the equipment has wider uses and that as the company claims, "Chemco has a Complete Water Conditioning Service." If you are interested in any of these bulletins or Chemco Service, write the Chemical Equipment Co., 223 Center St., Los Angeles, Cal.

Just in case you didn't hear John Hassler and Martin Faye of Industrial Chemical Sales read their paper on the Influence of Various Chemicals on Palatability of Drinking Water at Milwaukee last June, and if you didn't read it in the *Jour. AWWA* in Nov., 1944, you can find it in the **Taste and Odor Control Journal** for March, 1945. This is the journal which carries on its masthead the notation, "One Month Nearer Victory," and is published by Industrial Chemical Sales Division of West Virginia Pulp and Paper Co., 230 Park Ave., New York, N. Y.

The article itself contains information on 16 filter plants, involving different types of supplies and sources of contamination. Data are presented on the effect of chlorination, chlor-ammination and carbon treatment on odors. The effect of carbon with and without both chlorine and ammonia-chlorine is likewise shown. The summary seems to indicate that chlor-ammination and activated carbon constitutes best combination for improving the palatability of water in the greatest number of instances studied.

In **Modern pH and Chlorine Control** (6th Ed.) by W. A. Taylor & Co. of Baltimore, there is a rather complete discussion of pH, a fact which did not surprise us. Perhaps, also, we should not have been surprised to see in the catalog section of the booklet a Midget Dalite Lamp for use with single slide comparators, but we were surprised for we were not aware of its exist-

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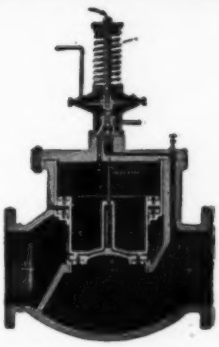
ence. It looks as though it should be a handy gadget for determining color comparisons in dark rooms, at night, or where trees, walls or other interferences are annoying to the analyst. This booklet-catalog may be obtained by writing the W. A. Taylor Co., 7300 York Road, Baltimore 4, Md.

Stop Check Single Acting Altitude Valve



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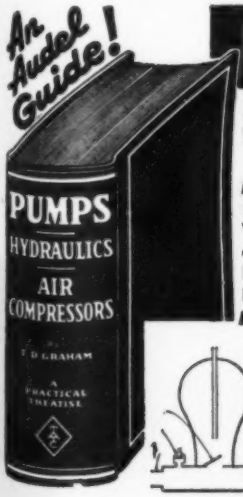

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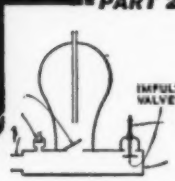

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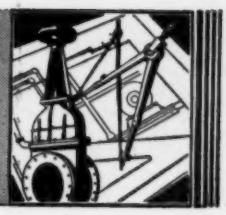

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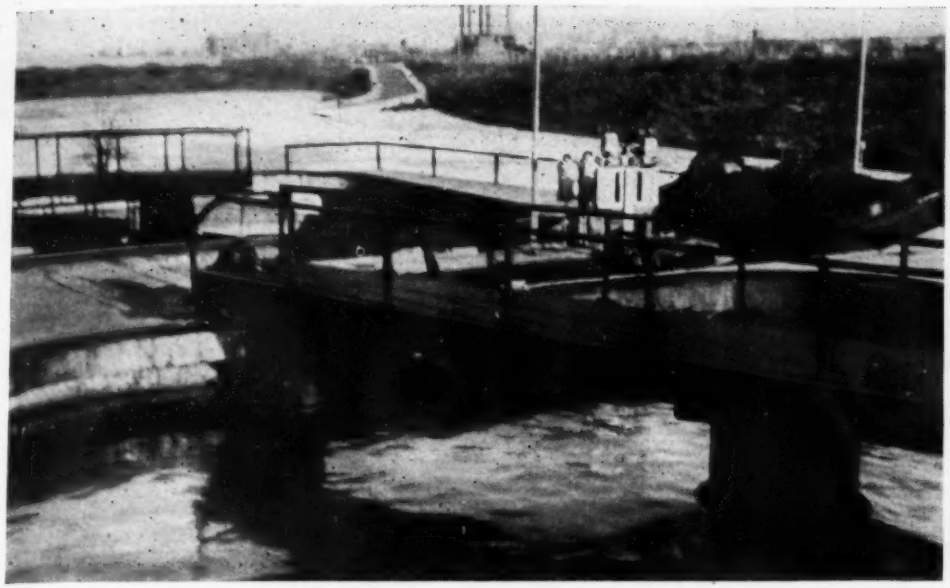
Grit Removal Problem at Springfield, Mass. solved by DORR ENGINEERS



The Dorrco Detritor, a continuous, mechanically-operated grit chamber, produces a clean, well-washed and drained grit suitable as a fill. Sewage enters the Detritor through deflectors on one side of a square tank and after depositing its grit, overflows a weir on the opposite side. A revolving mechanism rakes the deposited solids into a chute which discharges them into the grit-washing channel. The grit is then carried up the sloping channel, washed, drained, and deposited. The washing mechanism may be arranged to discharge the grit above grade into a truck if desired.

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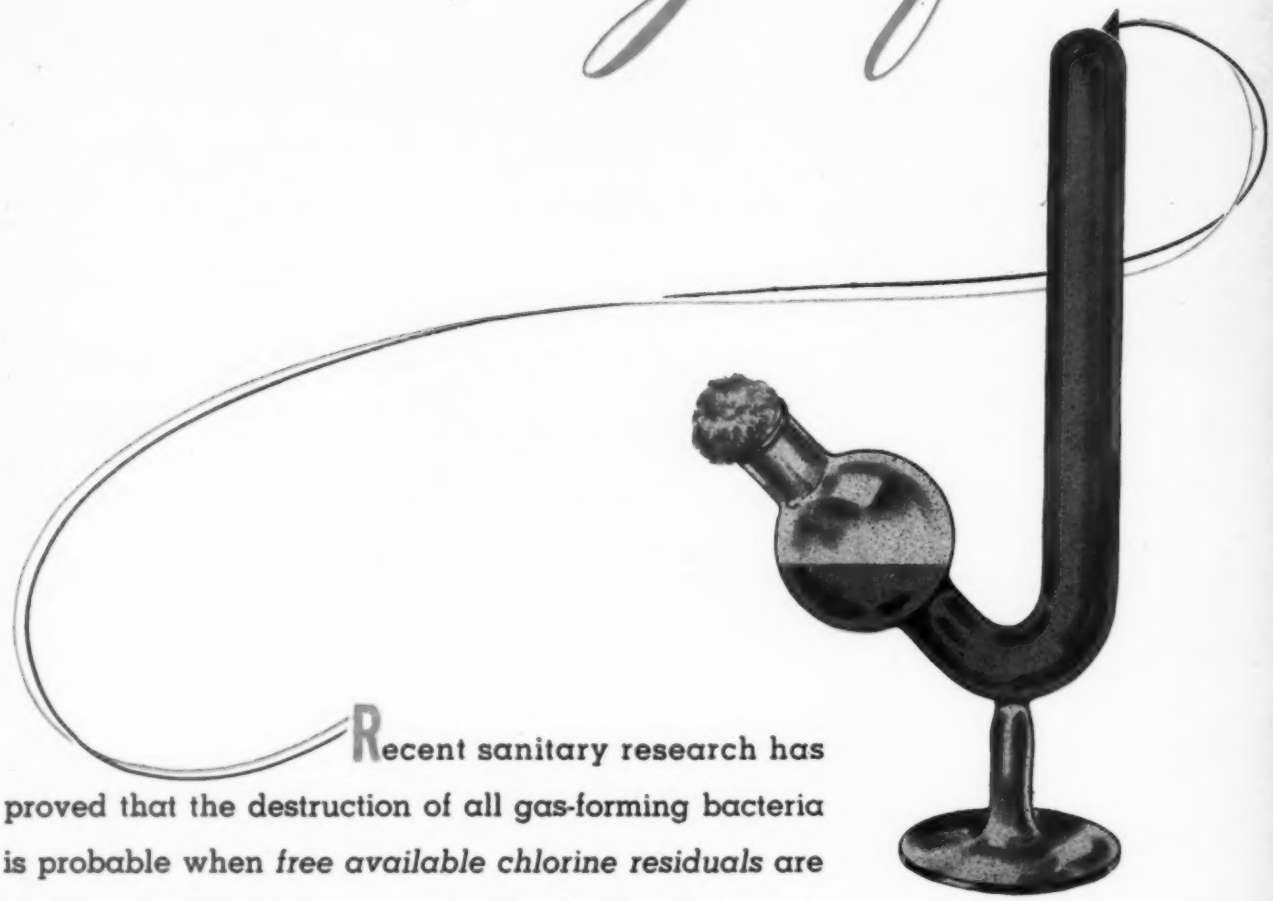
DESTRUCTION OF ALL *Gas-formers*



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The best and surest method for maintaining such residuals is by Break-Point Chlorination, which also frequently results in taste and odor reduction.

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